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THE NAVY PUBLIC WORKS CENTER SAN DIEGO CRAFTSMEN PRODUCTIVITY ANALYSIS

by

Scott Jacob Waidelich, B.S., M.B.A.

THESIS

Presented to the Faculty of the Graduate School

of The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE IN ENGINEERING

The University of Texas at Austin

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THE NAVY PUBLIC WORKS CENTER SAN DIEGO CRAFTSMEN

PRODUCTIVITY ANALYSIS

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ABSTRACT

THE NAVY PUBLIC WORKS CENTER SAN DIEGO CRAFTSMEN PRODUCTIVITY ANALYSIS

by

Scott Jacob Waidelich, M.S.E.

The University of Texas at Austin, 1997

SUPERVISOR: John D. Borcherding

By using a craftsman questionnaire, this thesis identifies and ranks the most important factors impairing craftsmen productivity and morale at the Naval Public Works Center, San Diego, California. In addition, the author provides recommendations to eliminate or reduce the management constraints which are causing unfavorable productivity and lower morale levels. Data for this study came from 46 surveys completed by specific work craftsmen assigned to one of the Public Works Center's four satellite maintenance zones and the Housing Maintenance Division, Code 552.

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Chapter 1

Introduction

1.1 Purpose

The purpose of this thesis is to:

- identify and rank the most important factors impairing productivity and morale of San Diego Public Works Center craftsmen;
- provide recommendations to eliminate or reduce the constraints which are adversely affecting craftsman productivity and morale.

1.2 Scope

Only journeymen in the Public Works Center (PWC) Production Services Department, who exclusively perform "specific" construction work, are analyzed in this thesis. "Specific" work is repair and new construction work which exceeds 200 man-hours of labor. Out of 100 surveys distributed, 46 surveys were properly completed, returned, and analyzed. All major work centers and every trade group within the Production Services Department, except the Asbestos Abatement Division, participated in the survey.

1.3 History of Construction Productivity Decline and Industry Performance

In 1994, the engineering and construction industry was this nation's second largest industry responsible for 13 % of the Gross Domestic Product (expenditures of 847 billion dollars) and employment of approximately 10 million people. In an article published in the May 1991 issue of Cost Engineering entitled "Future Directions in the

Engineering and Construction Industry," Edward S. Keen discusses some important trends in the construction industry. He reveals research that shows since the mid 1960's, construction productivity across North America has been declining at a rate of 1-2 % per year. Keen further explains that due to America's drop in productivity, loss of U.S. technological supremacy, and passage of stringent government regulations, foreign companies are increasing their share of the U.S. market and the U.S. share of foreign markets is declining.

As a result of a declining market share--and more frequent complaints from owners regarding ever-increasing costs, late completions, and poor quality--America's Corporate Business Roundtable chartered the Construction Industry Cost Effectiveness Project (CICE) in 1980. Their study of American construction companies found deficiencies in almost every aspect of the construction process. Findings ranged from the planning and design stages through the construction process itself.

The CICE Project produced 23 detailed reports. The CICE A-1 Report, titled "Measuring Productivity in Construction," found that there was no common industry definition of construction productivity. On the other hand, even when definitions were consistent, approaches to measuring input and output varied so greatly that valid comparisons between projects were impossible. The CICE A-6 Report, titled "Modern Management Systems" (November 1982), deals with present construction management practices. Highlighted in the report is the following statement:

> The construction industry has been criticized, to a large extent justifiably, for its slow acceptance and use of modern management methods to plan and execute projects. Many people both inside and outside the industry view this as a primary cause of serious delays in schedules and large cost overruns that have plagued the industry in recent years. Yet there is no lack of modern cost-effective management systems that can provide project managers with all the controls they need. Many owners and contractors do not seem to be aware of the economic payoff from appropriate use of modern management systems, and therefore are unwilling to

incur the cost of operating the systems on their construction projects.

As recommended by Business Roundtable studies, the Construction Industry Institute (CII) was created in 1983. Based at the University of Texas at Austin, CII actively performs research in key areas of construction performance. The second CII task force, "Productivity Measurement," sought to address many of the recommendations made by the CICE A-1 Report.

Realizing the importance of construction productivity to project cost and schedule control, one would expect to find volumes of educational materials describing productivity problem recognition and solutions. However, little information exists on what affects productivity and by how much. Some experts blame global issues such as the economy, union politics, or governmental regulations. Others blame poor employee work ethic. Nevertheless, those most closely associated with the construction industry acknowledge that productivity improvement is a management function. Unwillingness or laziness of the work force--or union interference--is rarely the cause of poor worker efficiency. In summary, if the factors underlying the productivity decline can be identified, quantified, and solved, improved competitiveness and profitability can be achieved.

1.4 Impact of Budget Cuts on the Navy

Congressional budget reductions on the Department of Defense (DoD) are forcing changes in the Navy shore and afloat programs which are affecting its sailors and civilian work force. There is not enough money in the DoD budgets to pay all the operational expenses or maintain and recapitalize the military infrastructure needed for the future. In the large scheme of mission essential imperatives, the cost of owning and operating the shore infrastructure is consuming too much of the limited resources available. The Navy of the future will have a smaller work force and fewer bases with

an aging infrastructure that will be in need of maintenance and recapitalization. Competition for scarce monies will increase the need to reduce the cost of maintaining its shore infrastructure. Of the 25.4 billion dollars budgeted for Navy Infrastructure/Installations Costs, 8.6 billion falls under the purview of the Naval Facilities Engineering Command (NAVFAC). Accepting the reality of future resource constraints--driven by a compelling requirement to optimize customer support--NAVFAC must develop and implement initiatives that reduce infrastructure costs while improving the delivery of products and services to the shore establishment. Thus, NAVFAC's efforts must reduce requirements and costs while maintaining quality.

Outsourcing, privatization, regionalization, and reorganization are recurring remedies which offer many benefits, but they may produce negative consequences if applied inappropriately. None of these is a panacea for all that ails the government, but judicious application of these tools in certain circumstances is undoubtedly the best and only solution. In fact, a blended mixture of these solutions must be used within NAVFAC and the PWCs to provide the Navy with improved services at lower costs.

Public Works services comprise about one half of the 8.6 billion dollar infrastructure costs. However, significant forces of change are challenging current Public Works support methods. Downsizing, base closure, and realignment are three major forces which are significantly affecting future public works operations. Ironically, a recent base Commanding Officer's poll identified Public Works as the number two barrier in accomplishing the base mission. Although the Public Works Centers were created to support and serve the fleet, many of its employees forgot that tenet, thinking the fleet existed to provide their jobs. In short, many public works employees looked upon the fleet as a nuisance, rather than a customer. This survey was a wake-up call to the PWCs, and they are now actively trying to recover. To put it briefly, the PWC's must embrace change. This clear customer dissatisfaction

warrants immediate response. Core delivery processes must be reengineered, and innovative business practices that respond to customer's needs must be implemented.

Chapter 2 of this thesis will provide the reader with an overall view of a typical Navy Public Works Center. Chapter 3, Literature Review, presents the findings of three independent productivity studies. Chapter 4, Research Methodology, discusses the:

- craftsman questionnaire used to collect the data,
- problems encountered in data collection, and
- organization and analysis of the data.

The questionnaire results are presented in detail in Chapter 5, and Chapter 6 presents the author's conclusions and recommendations.

Chapter 2

The Navy Public Works Center

2.1 Mission and Organization

Public Works Centers are responsible for essential functions that enable the Navy's largest bases to operate. PWCs provide all aspects of the following services:

- Utilities- gas, water, electric, sewer, steam;
- Maintenance- repairs to buildings, roads, and equipment; minor construction, preventive maintenance, emergency service, landscaping;
- Transportation- leasing and maintenance of trucks, sedans, construction equipment, cranes, barges, and railroad;
- Engineering- facilities planning, field engineering, topographic and hydrographic services;
- Navy Family Housing- maintenance of housing, landlord services;
- Environmental Improvement- trash collection and disposal, oil spill clean-up, and hazardous waste disposal.

PWCs form a multi-national "corporation" employing over 14,000 workers and serving 2,500 different Navy activities from Florida to Japan. The ten PWCs are located in San Diego, California; Pearl Harbor, Hawaii; Jacksonville, Florida; Norfolk, Virginia; Guam, Marianas Islands; Washington, D.C.; Yokosuka, Japan; Great Lakes, Illinois; and San Francisco, California (closing). Each PWC falls under the jurisdiction of the area Naval Base Commander or another appropriate area Commander. The following departments are typically found in each PWC: Human Resources,

Comptroller, Material, Contracts, Engineering, Utilities, Transportation, and Environmental.

2.2 Categories of Work

Maintenance, repair, and minor construction projects requested by customers can be accomplished either by a private contractor or PWC craftsmen. Determination of the method of accomplishment is normally made by a work review board comprised of a Customer Representative, Zone or Assistant Zone Manager, General Foreman, and Contract Specialist. Urgency, cost, technical/skill requirements, customer desires, and PWC backlog are the criteria typically used to decide whether the work remains in-house or goes contract.

Contract work normally takes longer to accomplish, as it typically requires the preparation of plans and specifications as well as formal solicitation and contract award procedures. It is also less flexible, in that once a contract has been awarded, any changes must be negotiated for cost and time. In-house work is usually a faster method of accomplishment, but depends on the priority of the project and material availability. Formal design by a registered architect/engineer is not required for most in-house projects.

A plan for the project, called a "job plan," is developed by a zone Planner and Estimator (P&E) prior to the start of work. The job plan includes:

- defining and controlling the scope of work,
- preparing shop drawings,
- completing the material take-off,
- sequencing the project's construction activities by trade,
- detailing the materials to be used and preparing their requisition documents,
- developing the project's man-hour estimate, and

- specifying the recommended method of installation.

The major factor determining the length of time before starting an in-house project is material procurement time. In-house work is typically performed on a cost reimbursable basis, although PWC has begun offering fixed-price projects when practicable. The concept of reimbursable work is logical, but in the customer's eyes, a history of project cost overruns has significantly lowered the PWC's project management credibility. To redeem their credibility, the PWCs should make fixed-price work the standard, and cost reimbursable work the exception.

2.3 Types of In-House Work

In-house work can further be divided into the specific manners in which work is executed. Table 2.1 illustrates these divisions. The PWC Maintenance Department is the primary executor of all maintenance, repair, and minor construction projects.

Type of Work	Description of Work	Response Standard
Recurring Work	Routine preventive maintenance, pest control, HVAC, fire protection, lighting, pools	Weekly or monthly
Emergency/Service Work	Work of small scope or emergency responses which are later converted into larger projects	Less than 16 man-hours of labor
Minor Work	May be planned or unplanned. Planned Minor Work has a scope of work written by P&E. Unplanned Minor Work has no written scope of work except the customer's request. Materials for unplanned work are ordered by the journeyman assigned to complete the work.	Ideally between 16-200 man-hours of labor. Sometimes has a tendency to grow because of scope creep or funding constraints.
Specific Work	All Specific Work is planned by a P&E and the customer receives a cost estimate prior to the start of the job. Average project costs range between $22K-$37K.	Greater than 200 man-hours of labor and usually large quantities of materials.

Table 2.1: Categories of In-House Work with their Response Standards

Chapter 3

Literature Review

3.1 Background

In this section, three reference documents will be discussed and summarized. The first document, "Productivity Review and Analysis of the ABC Company, Public Works Center San Diego," was completed by E.L. Hamm & Associates, Inc. in July of 1986. The second document is a thesis completed in August 1979 titled "Factors Influencing the Motivation and Productivity of Craftsmen and Foremen on Large Construction Projects", written by Douglas Frank Garner, graduate student; John David Borcherding, Associate Professor; and Nancy Morse Samelson, Research Associate. The third document, entitled the "Super Bee Project" is a formal report prepared by consultants Richard L. Tucker, John Borcherding, Mike Casten, and Greg Howell for the Motivation and Productivity Committee Conoco/Monsato Joint Venture and Brown and Root, Inc. in 1980.

Dr. Tucker, Dr. Borcherding, and Gregory Howell are all registered professional engineers and independent consultants who are nationally recognized as experts in the fields of Construction Engineering, Project Management, and Construction Productivity. Dr. Tucker is the Construction Engineering and Project Management Program Leader at The University of Texas at Austin. He is also Director of the Construction Industry Institute (CII) and holds B.S., M.S., and Ph.D. degrees in Civil Engineering from The University of Texas at Austin. Dr. Borcherding is an Adjunct Professor in Civil Engineering at The University of Texas at Austin and holds M.S. and Ph.D. degrees in Civil Engineering/Construction Management from Stanford University. Gregory Howell is an Associate Professor of Civil Engineering at the University of New Mexico at Albuquerque and a consultant who specializes in the organization and management of construction projects. Howell earned his B.S. and

M.S. degrees in Civil Engineering from Stanford University. He is co-author of the textbook "Productivity Improvement in Construction," and served in the U.S. Navy Civil Engineer Corps (USNR) with the Seabees in Vietnam and as Aide to the Commander, South West Division, Naval Facilities Engineering Command.

3.2 E.L. Hamm Productivity Review and Analysis Study

The purpose of the E.L. Hamm study was to determine the productivity of the ABC company and to make recommendations designed to improve the overall efficiency of the PWC Maintenance Department. The methods and techniques used in the study were work sampling, comparative analysis, probability analysis, expert opinion, informal interviews, and employee opinion questionnaires. To the author's knowledge this was the first and only formal Public Works Center Maintenance Productivity Analysis performed by NAVFAC.

Work sampling is a simple and effective data gathering method which measures the job efficiency of the work force on construction projects. For work sampling analysis, the activity of each worker is observed at a specific instance in time and classified into one of the three major categories: Direct Work, Support Work (indirect work), or Non-Contributory Work. By examining how the various activities are distributed in the given classifications, management can detect particular areas that require improvement. The findings of the productivity rating can be used in a number of ways. At the foreman or superintendent level, it identifies specific situations in which the work can be done more effectively and efficiently. Such obstacles as inefficient work layout, inadequate material placement and handling, and poorly-sized or unbalanced crews are among the candidates for improvement. However, work sampling alone does not reflect the true performance level of the craftsmen. Work sampling is a measure of the time spent working, but it doesn't measure the efficiency

with which the craftsman is working. For example, a carpenter sawing with a skill saw will get more work accomplished than one who is sawing by hand. If both individuals are working, the sampler will classify both workers under the Direct Work category. Engineered performance standards coupled with stopwatch studies--and other methods of advanced estimating or work accomplishment--must be used to more accurately determine the craftsman's performance.

The historical average of the construction industry for Direct Work lies between 40 to 60%. The Specific Work sampling method used by E.L. Hamm was the High Frequency Method described in Chapter Three of the NAVFAC P-700 Engineers Manual.

Table 3.1 below defines the three categories of work:

Work Category	**Category Definition**
Direct Work	Activities directly involved in the actual process of putting together or adding to a unit being constructed are considered direct work.
Support (Indirect) Work	Activities that are not directly adding to the work at hand, but are essential to completing the unit of work such as handling material at the work site, receiving instructions, reading plans, job clean-up, and waiting while some other member of a balanced crew is doing productive work.
Non-Contributory Work	All other activities such as personal or idle time.

Table 3.1: Categories of Work Used in Work Sampling Analysis

The E.L. Hamm work sampling results for the ABC Company were...

- Direct Work Time 47.6%
- Support (Indirect) Work Time 37.1%
- Non-Contributory Work Time 15.3%

Interestingly, a twenty year average of work sampling data for Direct Work (data collected from various Austin construction projects) measured by graduate students at the University of Texas was also 47.6%. The indicated percentage of 47.6 means that for approximately 3 hours and 48 minutes of each eight-hour workday the craftsman is engaged in the performance of Direct Work. Based upon the P-701 General Handbook and numerous productivity reviews for Real Property Maintenance Activities (various military and government agencies), E.L. Hamm concluded that Direct Work productivity could increase to 65.2%. This could be accomplished by improving schedule and time management, defining job leaders, decreasing travel and material handling, and increasing owner/management job site visits by shop superintendents and general foremen.

Within the Support (Indirect) Work category is the time spent for job preparation. Job preparation identifies that portion of the craftsman's time used primarily to receive instructions from the supervisor and to obtain and put away tools and equipment used. Columns one and two of Table 3.2 summarize the time the craftsmen spent within each area of this sub-category and the historical average goals based on other work sampling studies performed by E.L. Hamm. The historical average goals are based on the P-701General Handbook, which supports the Engineering Performance Standards General Data including craft allowances, travel time, balancing delay, job preparation, etc. In addition, Hamm and Associates has performed numerous productivity reviews for Real Property Maintenance Activities of various military and government agencies and has developed historical proposed averages. The third column of Table 3.2 shows E.L. Hamm's recommended improvement goals for the ABC Company.

Summary of Time Spent for Job Preparation (based on 8-hour workday)							
CODE	SUB-CATEGORY	MEASURED		HIST. AVG. GOAL		ABC CO. RECOM. GOAL	
		%	Min.	%	Min.	%	Min.
211	Receiving instructions from supervisor	2.3	11.0	1.3	6.2	2.3	11.0
212	Getting & putting away tools and equip. at shop or tool crib	0.8	3.8	1.8	8.6	0.8	3.8
213	Lay out & put away tools, equip., & matl. at job site	11.2	53.8	3.5	16.8	3.5	16.8
214	Clean up job site	1.4	6.7	1.2	5.8	1.4	6.7
215	Personal clean-up at job site	0.2	1.0	0.2	1.0	0.2	1.0
216	Safety precautions	0.2	77.3	8.4	40.3	8.4	40.3
210	Category total	16.1	77.3	8.4	40.3	8.4	40.3

Table 3.2: Summary of Time Spent for Job Preparation

As the table above shows, sub-category 213 (Lay out & put away tools, equipment, and material at the job site) is extremely high compared to the historical average goal. Sub-category 213 equals 11.2%, or 54 minutes, which is 37 minutes higher than the historical average goal of 17 minutes. The four day work sampling observations revealed that four different craftsmen expended over one hour and 20 minutes during the workday laying out and putting away tools, equipment, and material at the job site. These craftsmen were observed unloading plywood, sheetrock, and other construction materials at job sites. The time expended was

required to complete the job, however, using skilled journeymen at a burdened hourly rate of $12.99 (1986 wages excluding overhead burden) is not the most efficient method of handling the tools, equipment, or materials.

The work sampling results indicate that the current method of laying out and putting away materials and tools was costing the ABC Company $42,731 per year ($12.99/hr x .9 hrs/day x 17 workers x 215 workdays/year). Using the historical average goal of 17 minutes or 3.5%, the cost is reduced to $13,294. At the time, E.L. Hamm recommended hiring a temporary WG-3 laborer and using WAE (When Actually Employed) workers to increase ABC Company's flexibility and productivity. The use of the Laborer/Helper in ABC Company should enable them to obtain the historical average goal (3.5% or 17 minutes for subcategory 213). The computations below show how one WG-3 Temporary Laborer/Helper will more than pay for itself in the first year.

Observed (213) Cost.....	$42,731
Proposed (213) Cost.....	$13,294
Total Proposed Annual Savings.....	$29,437
Annual WG-3 Temporary Laborer Salary...	$19,308
Cost Savings Remaining Per Year.....	$10,129

Another category of delay and inefficient work procedure discovered during this study was travel time. Travel time is that portion of the craftsman's time devoted to traveling to job sites, material and tool shops, additional work assignments, lunch, or other locations. Analysis of the ABC Company revealed that 12% of the observed 48 minutes of travel was unnecessary.

The following observed practices contributed to excessive time in this category. Workers:

- started work at the shop instead of the job site.
- returned to the shop at the end of the workday.
- returned to the shop for tools, equipment, materials, or instructions during the workday.

To eliminate excess travel time, management needs to preplan what is needed for the entire next day and visit the work sites near the end of each day to inform workers of the following days assignment. E.L. Hamm also suggested that management should visit sites more frequently and carry a phone activated beeper for continual access. Increased site visits by the managers could reduce the craftsman's time spent answering customer questions, locating materials, and coordinating work at the site.

Table 3.3 is a summary of personal Non-Contributory/Non-Productive time. As illustrated, codes 312 (idle time), and 314 (coffee breaks/rest periods), exceed the historical average goal percentages and should be addressed. Most of the 35 minutes a day of idle time occurred directly before and after lunch, and at the end of the day. This is excessive and requires immediate reduction. Occasional early stops by workers are acceptable at times, but should not be a normal event. Management should stop this practice before it becomes routine. Through more frequent site visits and occasional reminders of standard workday hours, management should be able to reduce the 35 minutes of lost time. E.L. Hamm's recommended goal for idle time is 1.6%, or eight minutes/day.

1986 Summary of Personal Non-Productive Time (based on 8-hr workday)							
CODE	SUB-CATEGORY	MEASURED		HIST. AVG. GOAL		ABC CO. RECOM. GOAL	
		%	Min.	%	Min.	%	Min.
311	Head	0.4	2.0	.5	2.4	0.4	2.0
312	Idle-productive work available	7.2	35.0	2.6	12.5	1.6	7.7
313	Clean-up and dressing	0.1	0.5	1.4	6.7	0.1	0.5
314	Coffee break/rest periods	5.5	26.0	3.2	15.4	5.5	26.0
310	Category total	13.2	63.0	7.7	37.0	7.6	36.2

Table 3.3: Summary of Personal Non-Productive/Non-Contributory Time

Another informative and powerful study prepared by the consultant was an analysis of first and last productive effort. Table 3.4 provides the average times when the first direct productive effort took place in the morning, when the productive effort stopped and started at the lunch break, and when the productive effort stopped before quitting time. Portsmouth Naval Hospital and Karlsruhe Army Community were two highly productive installations during the time of this analysis. Portsmouth Naval Hospital and Karlsruhe Army Community's direct productivity were 63% and 66%, respectively. Their productive data are also included in Table 3.4. The data in this table strongly supports the use of the alternative work schedule where workers work nine hours a day for four days a week and eight hours a day on Friday with the alternate Friday off. By reducing the number of employee work days from ten to nine over a two week period, the PWC eliminates one day of lost productive time per employee (typically 55-127 minutes per day per employee).

Morning Start	Time Lost (min.)	Morning Stop	Time Lost (min.)	Afternoon Start	Time Lost (min.)	Afternoon Finish	Time Lost (min.)	Total Avgerage Productive Time Lost Per Person Per Day (min.)
ABC COMPANY								
0751	51	1035	25	1156	26	1603	27	129
PORTSMOUTH NAVAL HOSPITAL								
0711	11	1145	15	1247	13	1512	18	57
KARLSRUHE ARMY COMMUNITY								
0748	18	1150	10	1238	8	1541	19	55

Table 3.4: Comparative Average Productive Start/Stop Times

In conclusion, E.L. Hamm's productivity study and analysis of the ABC Company was very informative. The comprehensive report provided the PWC with specific productivity improvement recommendations. Unfortunately, it appears that the report's recommendations were "shelved" or too difficult to implement since many of the problems identified by the 1986 study are still present in 1996. E.L. Hamm recommended the following for changing and improving productivity, costs, efficiency and effectiveness:

- experienced multi-trade work force,
- rapid procurement of materials,
- improved job planning and facilitation by supervisors,

- appointed job leaders for each work site,
- limited company sizes of 30 craftsmen,
- competition within PWC causing companies to compete for work, and
- the adoption of the ABC work method of accomplishment over traditional PWC methods.

In the author's opinion, none of E. L. Hamm's recommendations were fully implemented. If they were, they were only implemented for a short time. Dr. John Borcherding, a nationally recognized expert on productivity improvement, has the same problem; it is easier to find what is wrong and offer improvement suggestions than it is to implement solutions. The author and Dr. Borcherding strongly feel that E.L. Hamm should have been retained to assist in the implementation of the productivity improvement recommendations.

3.3 Thesis (1979): "Factors Influencing the Motivation and Productivity of Craftsmen and Foremen on Large Construction Projects"

"Factors Influencing the Motivation and Productivity of Craftsmen and Foremen on Large Construction Projects" was a formal research study and thesis prepared and paid for by the Department of Energy (DOE). The study was conducted to analyze the most frequent and prevalent factors adversely affecting the motivation and productivity of craftsmen and foremen on large energy construction projects. Twelve projects within the United States were studied. They included ten nuclear power plants, one large non-nuclear power plant, and one smaller nuclear related facility. The primary data collection tool was a craftsman questionnaire supplemented by craftsman and foreman interviews and general foreman questionnaires. The PWC craftsman questionnaire is a modified version of the one used in the DOE study.

Problem areas studied and compared were:

- material availability
- tool availability
- re-work
- craft turnover
- foremen changes
- crew interfacing
- overcrowded work areas
- inspection delays
- craft absenteeism
- foreman incompetence

The most severe difficulty encountered in the study was material availability. Sixty-two percent of the craftsmen questioned indicated material availability as a significant deterrent to productivity. Tool availability and re-work tied for the second biggest problem area. Overcrowded work areas placed third. The author's relative index rating system is another means of ranking problem areas with the largest score as the most severe. A third method for ranking problems is the lost man-hours analysis. Table 3.5 is a statistical summary of the craftsman questionnaire.

Overall Statistical Summary of DOE Craftsman Questionnaire			
Problem Area	**Hrs/Week Lost**	**% Craftsmen Indicating Problem**	**Relative Index Score**
Material availability	6.27	62.0	.41
Rework	5.70	59.0	.28
Tool availability	3.80	52.0	.28
Overcrowded work areas	5.00	49.0	.15
Inspection delays	2.66	41.0	.11
Crew interfacing	3.29	36.0	.07
Instructions time	2.12	Not Computed	Not Computed

Table 3.5: Overall Statistical Summary of DOE Craftsman Questionnaire

As shown in Chapter 5 (Questionnaire Results), PWC craftsmen performing short-term Minor construction experienced similar problems (Material and Tool Availability) as craftsmen working on long-term, large scale construction projects. Rework and overcrowded work areas were not significant problems in the PWC study. This dissimilarity is most likely due to the difference in project complexity and degree of engineering required. Inspection delays were not considered in the PWC study because stringent inspection is inherent to the nuclear power industry. Specific questions relating to craft turnover and craft absenteeism were not included in the PWC survey for three reasons. First, a review of several years of PWC's absenteeism records did not indicate a problem. Second, base closures, coupled with a severe recession in California and high unemployment, created an atmosphere where both white and blue collar workers were fortunate just to be employed. Third, many of the reasons for a high turnover in energy-related construction projects are not present in PWC San Diego. These include poor working conditions, excessive security measures, inadequate benefits, remote job location, job security, and lack of accomplishment and job satisfaction due to project size.

The DOE study also correlated the amount of unproductive time and rework time with project completion. This research proved that unproductive time increased substantially during the first half of construction and leveled off later. Similarly, rework time was greatest during the first third of construction and leveled off during the last two-thirds of construction. Other trends and correlations that developed were:

- productivity vs. size of the work force,
- productivity vs. craft turnover,
- productivity vs. number of QA/QC personnel,
- productivity vs. craft absenteeism, and
- productivity vs. engineering design lead time.

For the results of the aforementioned correlations as well as additional information on trend identification, the reader is encouraged to refer to Chapter 4 of the DOE study and Sloan and Borcherding's Master's Thesis entitled "A Study of Relationships Between Site Characteristics & Craftsmen on Construction Problems of Nuclear Power Projects."

Chapter 5 gives an in-depth literature review of the theory of motivation. Chapter 6 summarizes the craftsman motivational interview results, and Chapter 7 discusses the foreman motivational interview findings. According to Dr. John Borcherding's article, "Motivating for Productivity," there are five motivational factors that can have significant influence on productivity:

1. Management must ensure the elements of work are available to allow craftsmen to complete assigned tasks.
2. Greater work force participation in problem-solving and decision-making.
3. A work environment which recognizes employees for outstanding job performance.
4. Goal setting at the project and crew level.
5. A fair financial incentive program which rewards craftsmen and foremen for productivity improvement.

Dr. Borcherding concluded that well-organized tasks, permitting people to be more productive, leads to job satisfaction. This idea contrasts the theory that job satisfaction leads to productivity. His research shows that satisfaction and dissatisfaction stem from very different roots. And in construction, satisfaction is inherent in the work itself. Smooth work flow, rather than job enrichment, will improve job satisfaction and productivity.

This means, essentially, that construction workers derive their greatest satisfaction from being productive on the job. Thus, they are happiest when the work is well-planned and on schedule. Moreover, their dissatisfaction comes when errors in

planning, scheduling, materials, and other factors occur outside their control. If supervisors practice the principles of good management--which ensures the elements of work are provided to their employees--the highest level of motivation will be realized. To learn more about motivation in the construction field, the reader is encouraged to read Chapters 5, 6, and 7 of the DOE study as well as the following three articles co-authored by Dr. Borcherding:

- "Job Dissatisfactions in Construction"
- "Construction Productivity and Job Satisfaction"
- "Motivating For Productivity".

3.4 The "Super Bee Program"

The "Super Bee Program" was a joint partnership between the client, Conoco/Monsanto Joint Venture, and the contractor, Brown and Root, Inc. With the assistance of consultants (Tucker, Borcherding, Howell, Ulkus, and Casten), the partnership was designed to implement a Productivity Improvement Program (PIP) on the cost-plus Chocolate Bayou Project in late December, 1979. Construction started in early 1978; at its peak, the project employed approximately 2700 craftsmen. At the time of PIP implementation (later called the Super Bee Program), the project was 50% complete, over budget, and behind schedule. Craftsmen morale was low, and employee turnover and absenteeism were high.

The consultants were responsible for formulating and initiating the PIP by training on-site personnel for its management and implementation, time-lapse filming the construction, collecting productivity data, and reviewing its progress. They selected a program manager from Brown and Root's management staff to implement the decisions of the committee. This position also entailed continuation of the program after the consultants were phased out. The major consulting effort occurred

from January to March, 1980. The Brown and Root program administrator was a full-time position and included a staff of two assistants and one secretary. In addition to administration and coordination, the program manager and his staff were heavily involved in work methods improvement. The PIP involved the following specific activities: worker motivation, training, work methods improvement, data collection, and feedback. Each of the key elements were derived from the consultant's successful experience of past projects.

The consultants used questionnaires, interviews, Foreman Delay Surveys (FDS), absenteeism rates, and time-lapse films to identify and solve specific project problems. The majority of the PIP effort centered around the project foremen since it is assumed that they represent the key focal areas for productivity improvement. Hence, most program features were constructed to assist foremen in guiding their crews. Intense training sessions were developed to teach foremen and general foremen how to plan, organize, staff, direct, control, and monitor their work. The FDS, an evaluation tool used periodically by foremen to identify factors affecting their crew's productivity, was used extensively. For detailed information on FDS, formal pre-planning for on-site construction, and data gathering for on-site productivity improvement studies, the reader is encouraged to refer to Howell's book entitled "Productivity Improvement in Construction."

The program name ("Super Bee") and emblem, job site posters, bi-weekly project newsletters, and awards program (Crew of the Month), were four direct motivational tools implemented to help cultivate a strong sense of project identification, ownership, and commitment. Indirect motivators were increased training programs, work methods improvements, questionnaires and interviews, and FDS. Low absenteeism, safety, and productivity were the tenets on which the awards program was based. Lectures, group problem solving, and case studies were the management training tools used to improve and develop foremen and general foremen management techniques.

In addition, a training reference manual and a comprehensive introduction on work methods improvement was provided to management.

Time-lapse film was used to identify areas where crew-level work methods improvement techniques would benefit. Films and the consultant's analysis of the films were presented to supervisors and craftsmen who were also asked to provide improvement suggestions. This aspect of the program was critical to productivity improvement because it illustrated that direct communication between the worker in the field and the manager in the office could occur. In the beginning, the biggest hurdle was convincing workers that change was possible and that management wanted and supported change to make their job easier and thus, more productive.

One significant work improvement method occurring early in the PIP was the drastic improvement of tool room procedures. A survey revealed that approximately 150 persons per hour were failing to obtain their desired tools and expendables. This was equating to approximately 300 lost man-hours per day. Therefore, the following steps were taken:

- a tool room problem solving committee was chartered;
- an additional tool clerk was assigned to each tool room;
- cut-off saws were added to various sites;
- an indefinite sign out period was established for safety belts;
- purchase procedures were revised;
- posters were added to tool rooms to remind the work force to report damaged tools and return tools that were checked out.

The results of the tool room study and its corrective action program were impressive. Tool room turn downs were reduced from 47% to less than 10% in an eight-week period. Most importantly, since this incident occurred early in PIP implementation and was widespread and highly visible, a sense of credibility of the entire PIP was firmly established. Similar positive results were achieved in material

distribution, project-level planning, and work methods improvement procedures.

Although the use of questionnaires and interviews is a different approach to determine craftsmen's perception of productivity, it was a very important element in the participative decision-making philosophy of the Super Bee Program. As mentioned earlier in this chapter, craftsmen want to be productive and become frustrated by circumstances which reduce their effectiveness. Their frustrations and perceptions are best captured by the use of questionnaires and interviews designed to obtain both quantitative and qualitative impressions of job progress. Although they are based upon opinions, hence subjective in nature, they reflect the perceptions of the work force and their working conditions. The questionnaires usually reflect the craftsmen's attitude as well as specific job problems.

By giving the craftsmen the opportunity to be heard, the interview and questionnaire process motivates them and strengthens their identification and commitment to the project. It is on this premise that the author selected the questionnaire process to determine the productivity constraints of the PWC San Diego work force.

Feedback was continuously shared with workers at all levels via project newsletters and management consultant meetings. Communication among workers, consultants, and management was the single most important item responsible for PIP success. Participative decision-making was continuously reinforced and practiced at all decision points. The project implementation costs were $250,000 and the estimated savings were $4,000,000. Significant quantitative improvements, such as craftsmen delays, were reduced by one-half in a two month period and absenteeism was reduced from 13% to 6%. Non-quantitative improvements between the contractor and owner increased cooperation and morale at all organizational levels.

Chapter 4

Research Methodology

4.1 Research Methodology Introduction

The data obtained for this study were obtained through a construction craftsman questionnaire. The questionnaire is a modified version of Dr. John Borcherding's survey developed in 1979 for the Department of Energy's nuclear power plant construction program. It was developed to identify, qualify, and statistically quantify the type and severity of problems which adversely affect and constrain the production and motivation of Public Works Center San Diego journeymen. The survey consists of fifty questions categorized into eight common inherent problem areas known to decrease construction productivity and adversely affect morale.

Table 4.1 illustrates the eight categories.

Problem Area	**Description**
Rework	The time and money expended performing work for a second time due to workmanship, design error, or changes.
Materials	Problems which result from material availability, lack of availability, or difficulty in obtaining or scheduling them.
Tools	Problems which result from tool availability, lack of availability, or difficulty in obtaining or scheduling them.
Equipment & Trucks	Problems which result from equipment & truck availability, lack of availability, or difficulty in obtaining or scheduling them.

Problem Area	Description
Crew Interference	Relates to delays caused by lack of coordination/scheduling of the trades
Crowding	Refers to interference caused by other crews or the physical layout of the job such as renovating a building while the customer still occupies it
Instructions	Refers to time spent waiting for and/or receiving direction from supervisors
Design Interpretation/P&E	Refers to the time spent waiting for design clarification or additional planning and engineering effort required to satisfactorily complete construction

Table 4.1: Productivity Constraining Categories

Each category of the questionnaire survey is comprised of four to six questions. The first question asked in each category resulted in a "yes" or "no" response to whether or not each particular problem occurs "often" (defined as every day or every other day). The second question asks the respondent to approximate how many hours per week were spent unproductively due to a specific problem area. The last question in the group is an open-ended question, asking the respondent how to improve or eliminate the problem. Responses to this question often illustrate the respondent's personal frustration and unmotivated attitude. See Appendix A for a copy of the questionnaire. All unanswered questions or ones indicating more than one choice were eliminated from the final analysis. The remaining responses were compiled and converted to percentages with applicable standard deviations calculated.

4.2 Collection of the Data

One hundred surveys were personally distributed by the author to the Assistant Zone Managers at an Assistant Zone Manager staff meeting in late December 1995. The surveys were divided into five sets of twenty, one set each for laborers performing specific work in Zones 1, 2, 3, and 4, and Code 552. A zone is a satellite public works support activity of the Public Works Center located at four separate San Diego Naval installations. Code 552 is a group of 69 journeymen performing only housing work in all zones.

One hour was allotted to complete the anonymous survey. The Assistant Zone Managers were asked to personally monitor the survey and ensure a representative sample of each trade was surveyed. For example, if 30% of their specific work force were carpenters, then six of the 20 surveys should have been completed by carpenters (20x30%=6).

Not one zone completed all twenty surveys, and most zone's survey samples were not a representative cross section of their zone work force. Therefore, a highly correlated comparison between zones showing possible interrelationships was not possible. The following number of surveys were received: Zone 1-18, Zone 2-4, Zone 3-7, Zone 4-8, and Code 552-9. Zone 1 came the closest to the author's request by completing 18 surveys with all crafts represented except construction mechanics and masons. As a result, the Zone 1 management summary report was the most informative, reliable, and conclusive compared to other zone management reports. Before being surveyed, respondents were informed that the survey was completely anonymous. It was further explained that the survey's purpose was to indicate key areas where management needed to improve their support of the work force.

4.3 Difficulties Encountered in the Data Collection

Forty-nine surveys were returned by May of 1996 with three of the original forty-nine surveys discarded due to inconclusive or erroneous data. An example of erroneous data is when the cumulative hours of lost time exceeded the standard 40-hour work week. Due to workload constraints, the surveys were not personally administered by the Assistant Zone Managers and in some cases were not given in groups or on company time. Although impossible to determine, the respondents may have viewed this as a lack of concern by management. The Assistant Zone Managers were the only individuals briefed in detail about the survey. Therefore, if an Assistant Zone Manager did not proctor the survey, respondents questions would have been answered by an unqualified peer or supervisor.

4.4 Organization and Analysis of the Data

Table 4.1 illustrates, by craft and zone, the number of journeymen performing specific work and the number and craft surveyed in each zone. All survey data from the forty-six surveys were entered into a Quattro Pro spreadsheet/database. Eleven different sorts were performed on the data with summary reports generated for each sort. The eleven sort categories were:

1) All work centers
2) Zone 1
3) Zone 2
4) Zone 3
5) Zone 4
6) Code 552
7) Carpenters
8) Electricians
9) Maintenance Workers
10) Sheetmetal Workers
11) Plumbers/Pipefitters

The sorts were selected to compare and analyze problematic areas by zone and trade type. Sorts for all trades were not performed because the percentage of each

trade surveyed, in some cases, was less than the respective trade percentage for all zones. For example, floor covers comprise 5.93% of the specific work force in the zones, but only 2.44% of the sample size surveyed represented floor coverers. Since plumbers and pipefitters perform similar work and are often used interchangeably, they were combined into one sort. Table 4.1 also lists the combined craft percentages for all zones as well as the craft percentage surveyed. Appendix B summarizes the report sort for all work centers. The ten other summary management reports are not included as appendices, but can be obtained from the author. Copies of all summary management reports were provided to the Public Works Center Production Officer, CDR John Snyder, in early June of 1996.

CRAFT	TOTAL SPECIFIC CRAFTSMEN/ZONE					TOTAL	% OF EACH CRAFT	# SURVEYED	% OF EACH CRAFT SURVEYED
	Z1	Z2	Z3	Z4	552				
Electrician	5	4	8	2	6	25	9.26	6	14.63
Sheetmetal	5	2	4	4	2	17	6.30	5	12.20
Pipefitter	1	0	1	0	0	2	0.74	2	4.88
Plumber	4	4	4	5	13	30	11.11	2	4.88
Floor Coverer	4	2	3	7	0	16	5.93	1	2.44
Const. Mechanic	4	3	1	0	1	9	3.33	1	2.44
Welder	1	14	2	1	2	20	7.41	1	2.44
Maint. Worker	4	0	5	0	1	10	3.70	3	7.32
Carpenter	8	4	5	2	14	33	12.22	11	26.83
Mason	1	1	3	2	21	28	10.37	2	4.88
Painter	15	18	6	5	7	51	18.89	5	12.20
Other	1	18	6	2	2	29	10.74	2	4.88
TOTAL	53	70	48	30	69	270	100.00	41	100.00

Table 4.2: Total Specific Manpower vs. Craftsmen Surveyed

4.5 Validity of the Data

The results of the survey questionnaire are subjective and represent the craftsmen's perceptions of job activities. However, due to the built-in redundancies of the survey and the end summary section, a fairly high level of consistency was achieved. Therefore, the results are believed to be highly representative of the day-to- day organizational constraints impinging on the work force's productive time. Even though surveys may be subjective, it is important to rectify problems perceived to be significant. It is not important if the work force says there is a three hour loss per week for tool problems, yet if carefully measured, it is only 2.25 hours. The important point is that tools are identified as a problem and management makes an effort to improve tool availability. A second survey would show any perceived improvement with the same level of accuracy.

Chapter 5

Questionnaire Results

5.1 Questionnaire Results Introduction

This section presents the results of the eight constraining problem areas for the 11 different sorts previously listed. Each subsection contains a discussion of the significant constraints and provides a graph illustrating the following:

- the percentage of those surveyed who perceived the constraint to be a problem;
- the perceived percentage of lost time caused by that particular constraint; and
- the percent greatest effect score for that specific constraint relative to the other problem areas.

The percent of lost time was calculated by dividing the average number of lost hours per craftsmen per week for the sample distribution by forty hours. The percent greatest effect was determined by the responses to questions 44, 45, and 46 of the survey which asked the respondents to rank the top three problems listed in question 43. Improvement of these problems would have the first, second, and third greatest positive effect on their job. A score of three, two, and one was then respectively assigned. The spreadsheet then totaled the scores for all sixteen problem areas listed and calculated their percent relative to the other categories.

The sample distribution included six electricians, five sheetmetal workers, two pipefitters, two plumbers, one floor coverer, one construction mechanic, one welder, three maintenance workers, 11 carpenters, two masons, five painters, and two miscellaneous tradesmen. The average trade experience for all craftsmen surveyed was 18.3 years. On average, 8.3 of these years have been with the San Diego Public Works Center. All survey responses and results were based on a forty-hour work week since the typical public works employee works an average of eighty hours every

two weeks. The average crew size was 2.6 workers.

5.2 All Work Centers

Figure 5.1 illustrates the percentage of each craft surveyed. Figure 5.2 summarizes the magnitude of the perceived problems for all eight productivity constraints. The overall average lost time per craftsman per week was 19.8 hours (approximately one half of the work week). According to studies conducted by Dr. Borcherding, an acceptable lost time average for maintenance work is ten hours per week. Sixty percent of the respondents viewed material operations as a major problem, 50% viewed design/engineering/planning and estimating as a problem, and over 40% perceived equipment and truck operations as a problem. Table 5.1 lists the average time losses per constraint in hours per craftsman per week for all eleven sorts. Although the sample sizes were small for all zones except Zone 1, Table 5.1 provides a relative comparison of average lost time in each problem area for each zone and selected crafts.

As noted in column one, the highest number of lost hours (4.4 hrs.) was attributed to material operations. Material operations also earned the highest score for percent greatest effect. This score indicates that it had the highest negative effect on job accomplishment. Twenty-three percent of the respondents ascribed the material problem to material not being placed prior to job assignment. Seventeen percent attributed it to material not delivered on time and not ordered with adequate lead time. The most common responses to question 14 (How do you think material problems could be improved?) related to issuing government credit cards to more journeymen and allowing journeymen to order their own materials directly from the vendor. These two steps would eliminate the need for the PWC material department. Additional craftsmen comments not discussed here clearly illustrate the craftsmen's frustration

caused by material problems. These comments are listed in Appendix B. In short, difficulties with material availability were consistently the most severe problems revealed by this study.

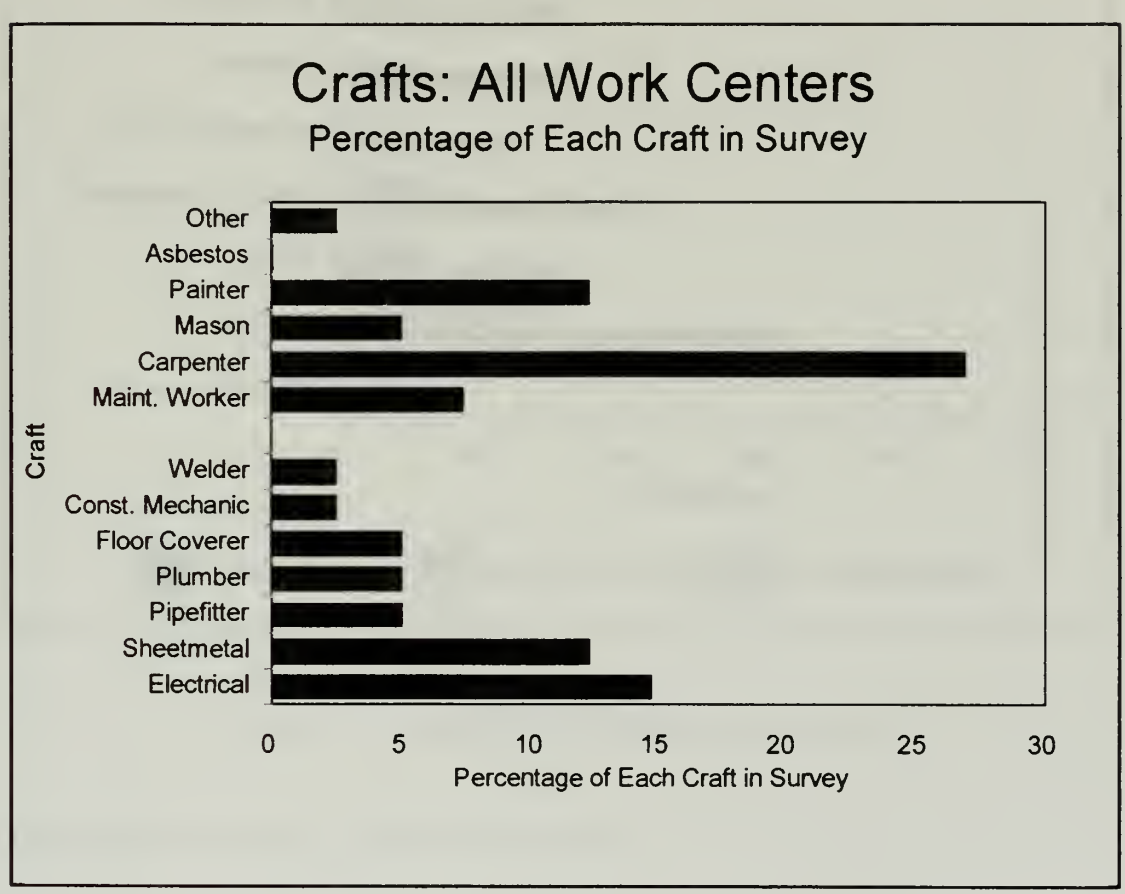


Figure 5.1: Crafts: All Work Centers

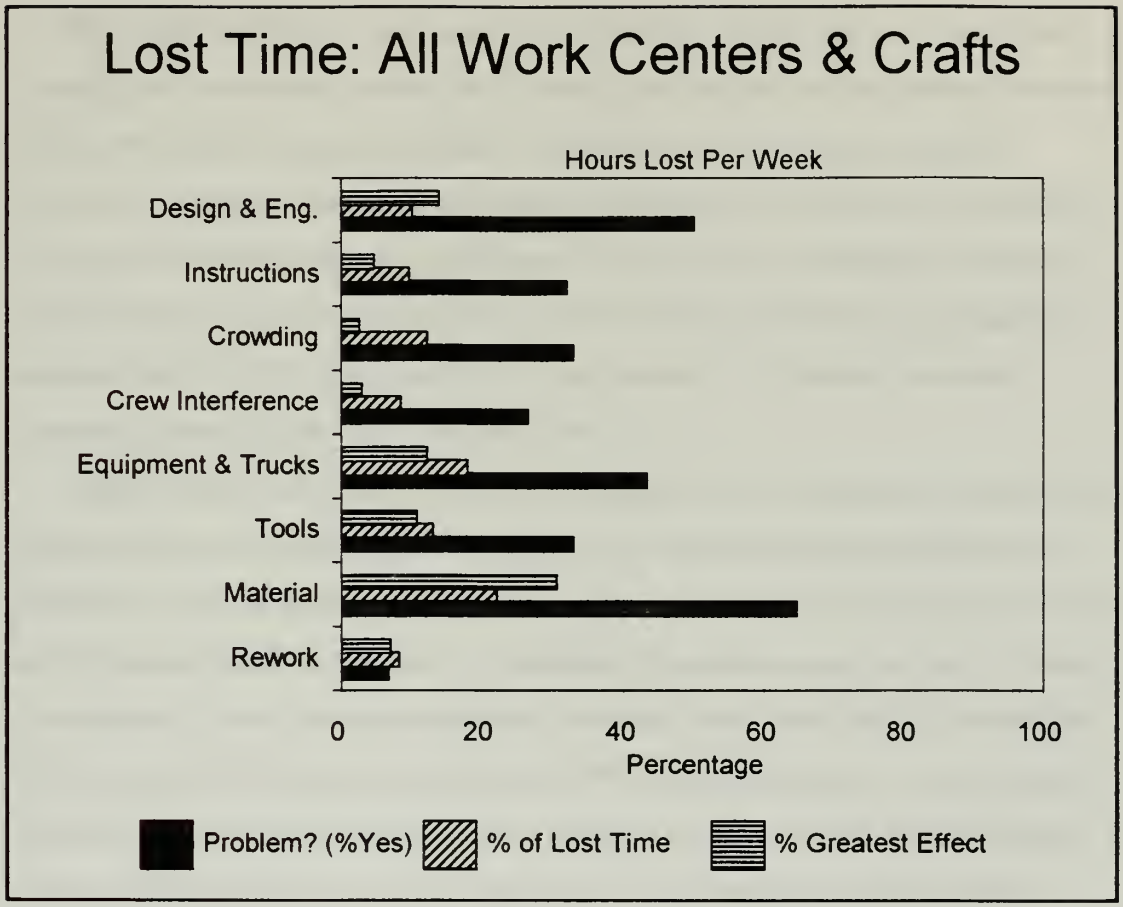


Figure 5.2: Lost Time: All Work Centers & Crafts

Explanation: For all like graphs in this document.

Problem? (%Yes)

% of Lost Time: Based on the lost hour each week for each problem shown here.

% Greatest Effect: Based on the weighted rankings of the problems indicated to have the three greatest effects.

The author feels that a long-term objective of the PWC should be to completely re-engineer the material process. In the short term, problem solving teams like those used in the Super Bee project should be chartered to look at specific material problems. In addition, the material department personnel located in the zone should be under the administrative and operational control of the Zone Manager. Finally, a second long-term goal should be that the PWC material department adopt business practices which use the automated electronic commerce contracting processes currently in use at China Lake Weapons Station.

Design interpretation received the second highest score for percent greatest effect, paralleling its second place (over 50%) finish as the second greatest problem area. However, it was the fourth highest (2 hrs.) in terms of number of lost hours per week per craftsman behind the problems of materials, equipment/trucks, and tools. Twenty-five percent of those surveyed attributed the design problems to lack of coordination between engineers/planners and estimators (P&E) and journeymen. The second and third reasons for engineering delays were respectively engineers/P&E's unfamiliarity with actual job conditions and poor drawings. The recurring comments for this problem were "more communication between the craftsmen, P&E, and customer" and "more pre-construction conferences."

Equipment and truck problems scored second highest on percent of lost time with an average of 3.5 hours lost per journeyman per week and third highest on percent greatest effect. The two causes which received the highest scores (25% of respondents) for equipment/truck problems were a shortage of trucks and the truck or equipment not arranged prior to job assignment. In addition to the frequent comment of "need more trucks" was the comment " need to schedule trucks/equipment." Zone uniqueness caused by diverse customer requirements-coupled with their dissimilar geographic service footprints-makes a detailed corporate truck/equipment improvement program unlikely to work for all zones. Instead, each zone should

develop a separate equipment program tailored to their specific needs. From the author's personal experience working in Zone 1 for two years, the problem is not the number of vehicles assigned to the zone, but rather their utilization and lack of scheduling. In short, all zones need to treat their vehicles as a scarce resource and do a better job sharing their vehicles among their internal work centers. Additional vehicle improvement suggestions can be found in Chapter 6, "Recommendations and Conclusions."

Productivity Constraints	All Zones Combined	Zone 1	Zone 2	Zone 3	Zone 4	Code 552	Carpenters	Electricians	Plumbers/PF	Maint. Wkrs	Sheetmetal Wkrs
Rework	1.6	1.7	1.5	0.7	2.6	1.1	2.5	1.0	0.5	0.3	0.2
Materials	4.4	5.4	4.8	**6.1**	1.5	3.8	4.4	5.0	2.7	3.3	6.1
Tools	2.5	3.7	4.0	3.5	0.8	0.6	2.3	2.6	1.3	2.3	2.5
Equip/Trucks	3.5	4.6	**14.3**	1.6	0.6	1.0	1.3	1.9	0.8	1.7	**13.9**
Crew Interfer.	1.6	2.9	0.7	1.0	1.3	0.6	1.0	2.2	0.0	0.7	0.5
Crowding	2.4	3.5	1.8	1.9	3.2	0.2	2.2	1.8	1.0	2.0	1.4
Instructions	1.8	2.2	2.5	0.4	1.5	2.1	2.6	1.3	0.0	1.0	1.0
Design & Engineering.	2.0	2.5	3.0	0.4	1.0	2.3	2.3	1.2	0.7	1.3	3.0

Table 5.1: Average Time Lost for Various Productivity Constraints in Hours Per Craftsmen Per Week

From the sample distribution, it appears that overall employee job satisfaction is very high. The most common comments were: "I like the people I work with"; "I like the variety of work assignments and opportunity to work outside my trade"; and "I have the freedom to make decisions which affect my project." Other positive remarks were: "good job security"; "sense of accomplishment from taking a job from start to finish"; and the alternate work schedule/ready day off (RDO). These encouraging comments indicate a work force with good morale and indirectly reflect management's use of Total Quality Leadership/Management. A final positive finding not mentioned in the survey was the absence of craftsmen comments regarding base closure or Reduction In Force (RIF) actions. This is a very strong sign that management is following its promise of no RIF at PWC San Diego.

Frequent journeymen dislikes included the pay; materials, tools, and equipment problems; and mixed signals from management regarding change with regard to work policy, rules, and procedures. Two other adverse comments mentioned twice by two journeymen from different zones are as follows:

- management did not promote the best qualified individuals to supervisorial positions, but rather unfairly promoted the "favored good old boys," and
- the inability of craftsmen to advance to a higher skill/grade level.

Another journeyman accused PWC middle management of squelching Total Quality Leadership for fear of losing their jobs. Although the journeymen "likes" outweigh the "dislikes," management must hear, listen, and immediately address negative comments to prevent jeopardizing the overall positive work force morale. Feedback to the work force should be accomplished through the chain of command and publicized through the employee newsletter, "The PWC Centerline."

5.3 Unavailable Tools and Consumables

The last section of Appendix B lists the comments to all of the survey's open-ended questions. In addition to the journeymen "like" and "dislike" questions were the unavailable tools and consumables questions. An unavailable tool and consumable report is provided at the end of Appendix B. Each Zone Manager was also provided an unavailable tool and consumable report specific to his zone's toolroom. Pneumatic tools and drill bits were the most common tools and consumables which the craftsmen had difficulty acquiring.

5.4 Zone 1

A discussion section of Zone 1 is included because their craftsmen represented 39% of all surveyed, representing all crafts except construction mechanics and masons. Individual discussion sections for other zones are not warranted because of their small sample size (four surveys from Zone 2) and lack of craft representation. Figures 5.3 through 5.6 are the lost time bar graphs for Zones 2, 3, 4, and Code 552. All statistical information is included in the respective management summary reports provided to each Zone Manager via the PWC Production Officer. Zone Managers are strongly encouraged to study these reports in depth, share the results with their staff and employees, and use the data to make, support, or implement changes which enhance productivity. In earnest, Zone Managers need to establish a productivity improvement effort that includes follow-up to the survey. Problem solving teams to improve material availability are warranted. In addition, suggestions for improvement should be implemented and communicated via the zone or PWC newsletters. A second survey is strongly recommended to measure the perceived results achieved by management's improvement actions.

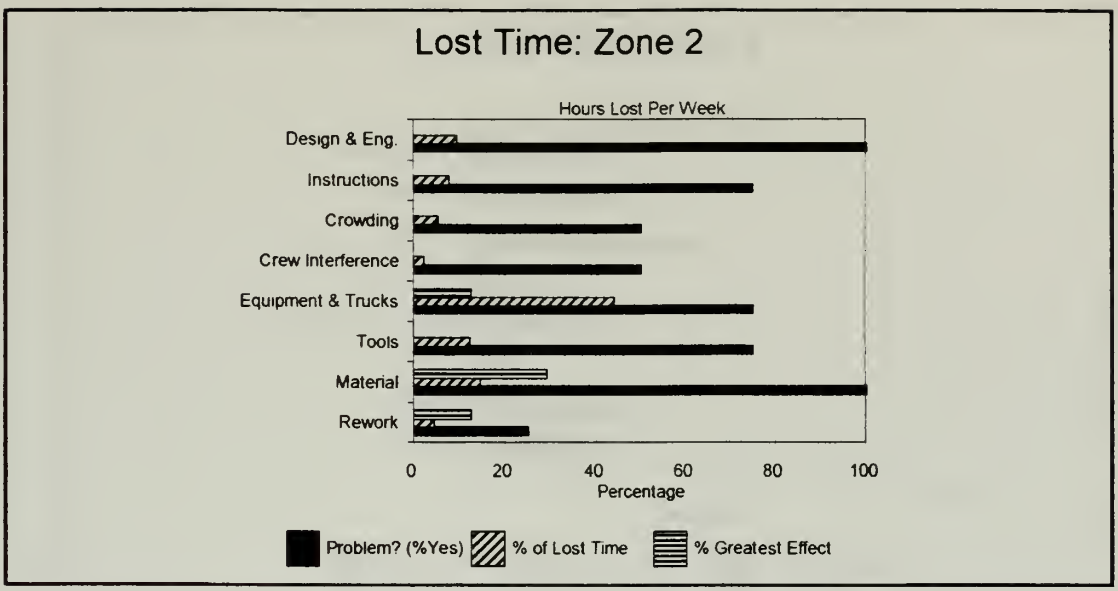


Figure 5.3: Lost Time: Zone 2

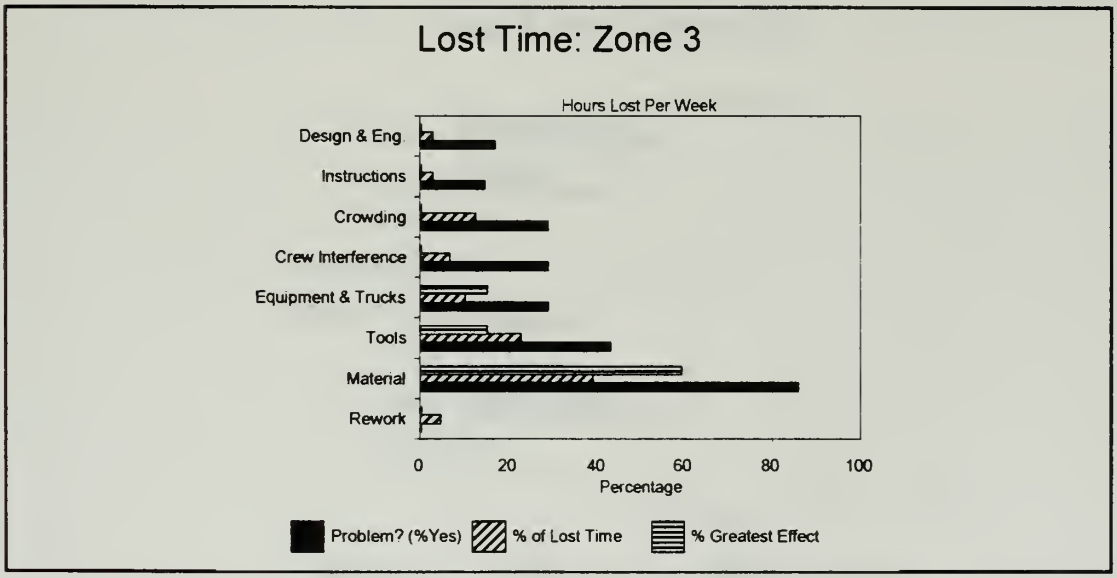


Figure 5.4: Lost Time: Zone 3

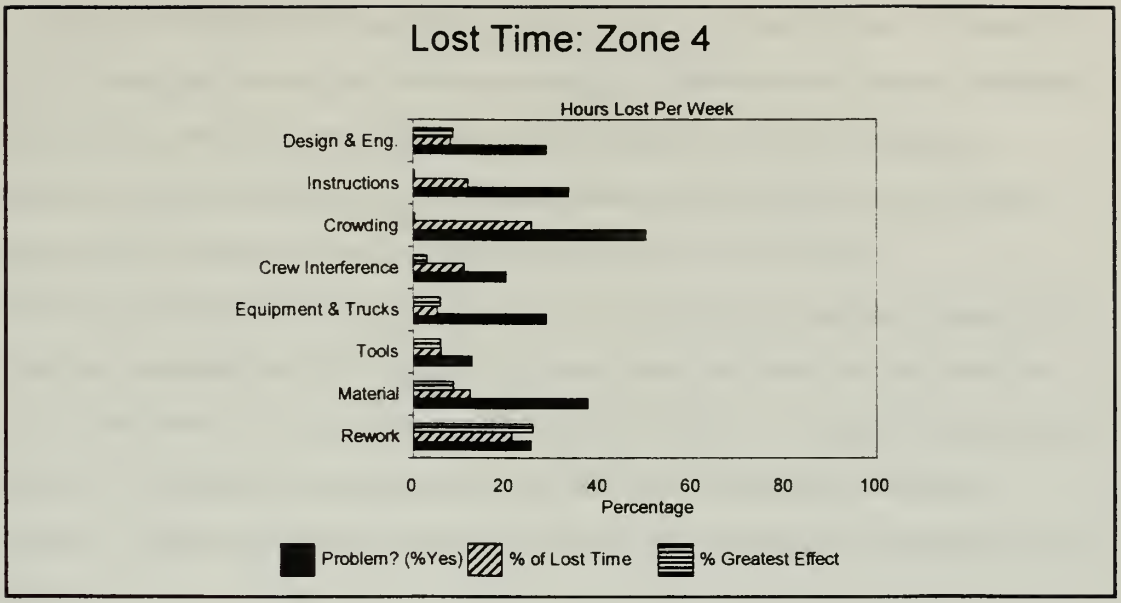


Figure 5.5: Lost Time: Zone 4

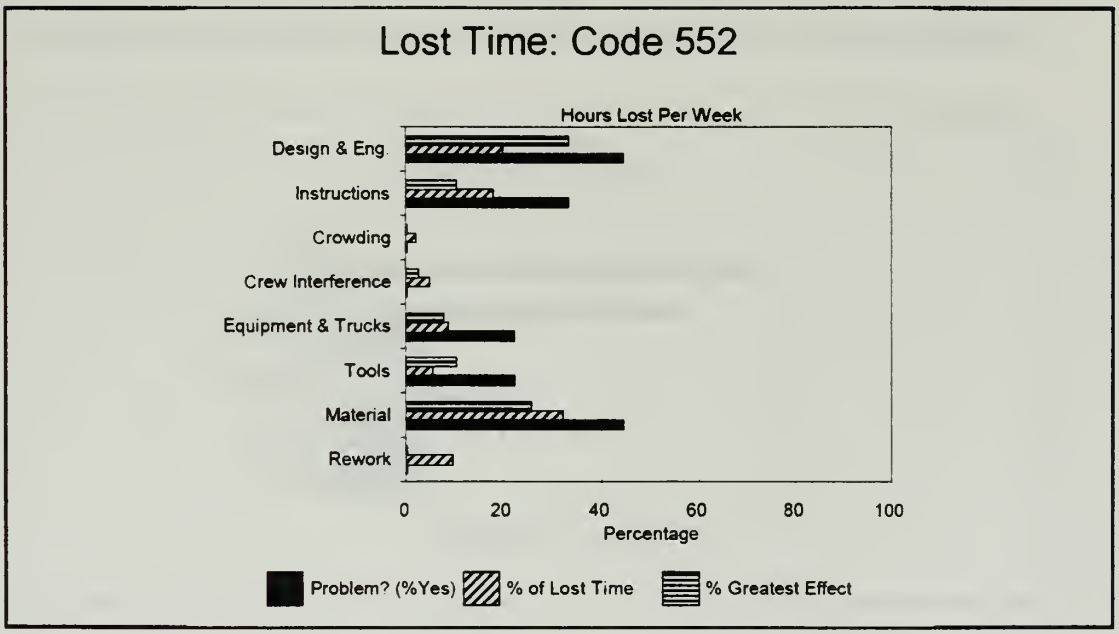


Figure 5.6: Lost Time: Code 552

Figure 5.7 illustrates the percentage of each craft surveyed in Zone 1. Figure 5.8 is the lost time graph which depicts the percentage of craftsmen who believe a particular productivity constraint exists, the percent of lost time per week per employee attributed to that constraint, and the relative percent greatest effect score for each productivity constraint. Based on this survey for Zone 1, 61.7% (24.7 hrs/week/craftsman) of the hours on the job are lost time. This number is more than twice the acceptable industry average of approximately ten hours lost per week for work of this nature. The top three problem areas for Zone 1 in order of severity are as follows: 1) material, 2) design/engineering/P&E, and 3) equipment and truck problems. These are identical in type and order to the composite survey report for all zones.

Material operations were viewed as a major problem by 71% of the respondents. Design/engineering/P&E is viewed by 63% as a problem, and 59% perceived equipment and truck operations to be a problem. As noted in column two of Table 5.1, the highest number of lost hours (5.4 hrs) was attributed to material operations.

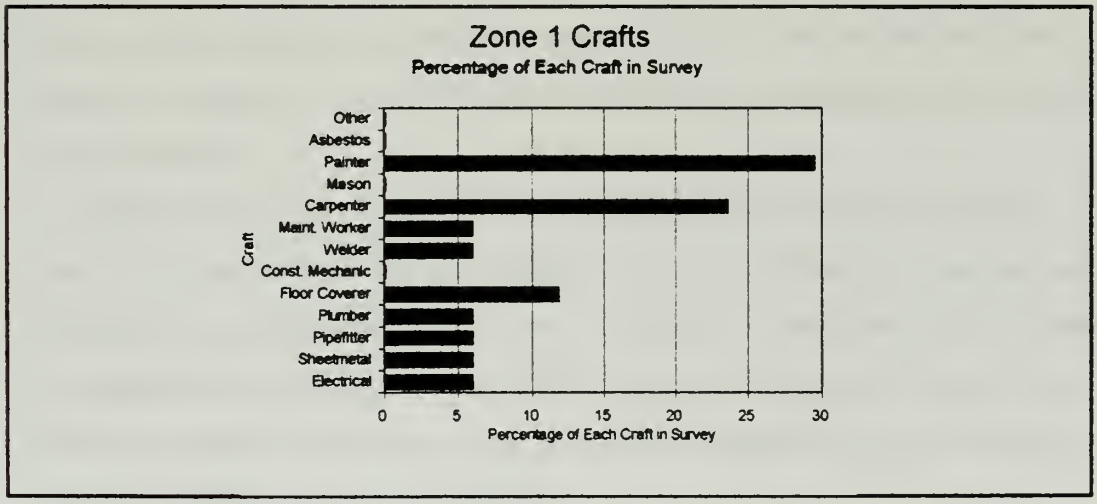


Figure 5.7: Zone 1 Crafts

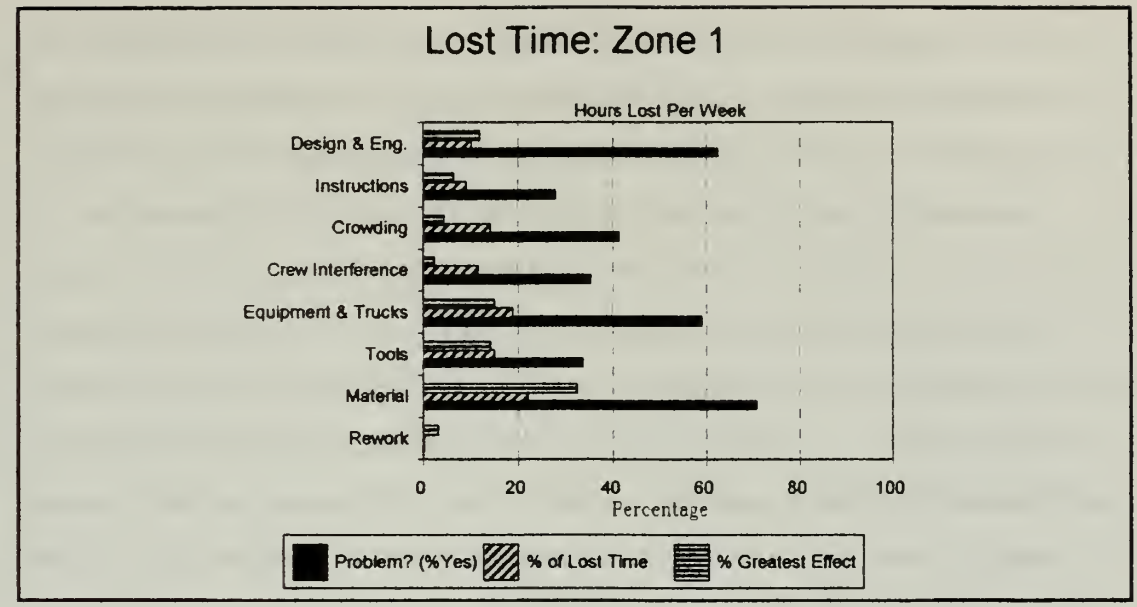


Figure 5.8: Lost Time: Zone 1

Material operations also earned the highest score for percent greatest effect, indicating that it had the highest negative effect on job accomplishment. Nineteen percent of the respondents ascribed the material problem to the material not located prior to job assignment, and another 19% attributed it to material not procured with adequate lead time.

Equipment and trucks received the second highest score for percent greatest effect. This parallels its second place finish (4.6 hrs) of lost hours per week per man scoring behind material problems (5.4 hrs). Of all Zone 1 respondents, 29% attributed the equipment/truck problem to an insufficient number of trucks, 26% credited the problem to failing to schedule the truck prior to job assignment, and 16% assigned blame to an inefficient check-out process.

Although design/engineering/P&E placed second as a problem for Zone 1, it was fourth and sixth, respectively, in terms of percent greatest effect and average time lost

per week per man. In Zone 1, tool problems accounted for an average of 3.7 lost hours per week per man. Twenty-six percent of Zone 1 respondents thought that there were not enough tools for the size of the work force and crews hoarded tools.

An interesting finding for all zones was the low score for the problem area--rework. In Zone 1, all 18 respondents answered "no" to the question "do you often spend time doing work over?" This atypical response may have occurred for two reasons. The most likely reason for this was the modifier "often" which meant, for the purpose of this survey, occurring every day or every other day. Another possible reason is the inconsistent definitions for rework that management and the work force have. Although this survey's results indicate rework as a non-problem, the author cautions management to keep a watchful eye on it. A PWC rework Process Action Team (PAT) determined the total cost of rework for all zones in fiscal year 1995 to be approximately $275,000. Although it is easy to calculate the hard dollars expended as a result of rework, it is very difficult to quantify the costs associated with low productivity and low morale as a result of rework.

5.5 Carpenters

Next to the painters, who represent 18.9% of the specific work force, are the carpenters, who represent 12.2 % of the specific work force. Eleven of the forty-six craftsmen surveyed (26.83%) were carpenters. Figure 5.9 is the lost time graph for carpenters. The top two problem areas were materials (4.4 lost hours per week per man) and design/engineering/P&E (2.3 hours lost per week per man). These were the same top two problem areas for the composite survey report for all zones and the Zone 1 sort. The third greatest problem area for carpenters was tool availability (2.3 hour lost per week per man). Tool availability was the fourth greatest problem found in the composite survey report.

Approximately 82% of the carpenters felt materials were a problem, 67% thought design/engineering/P&E was a problem, and 54% believed tools were a problem. Not surprisingly, 28% of the carpenters attributed the material problem to materials not located prior to job assignment and another 20% assigned the cause to materials not ordered with adequate lead time. These reasons were also the top two material problem causes in the composite and Zone 1 survey analyses. Thirty-one percent of the carpenters claimed the tool problem is a result of insufficient tool quantities for the size of the work force. Twenty-one percent attributed the problem to the tool room being too far from the work area. Sixteen percent blamed other crews for tool hoarding.

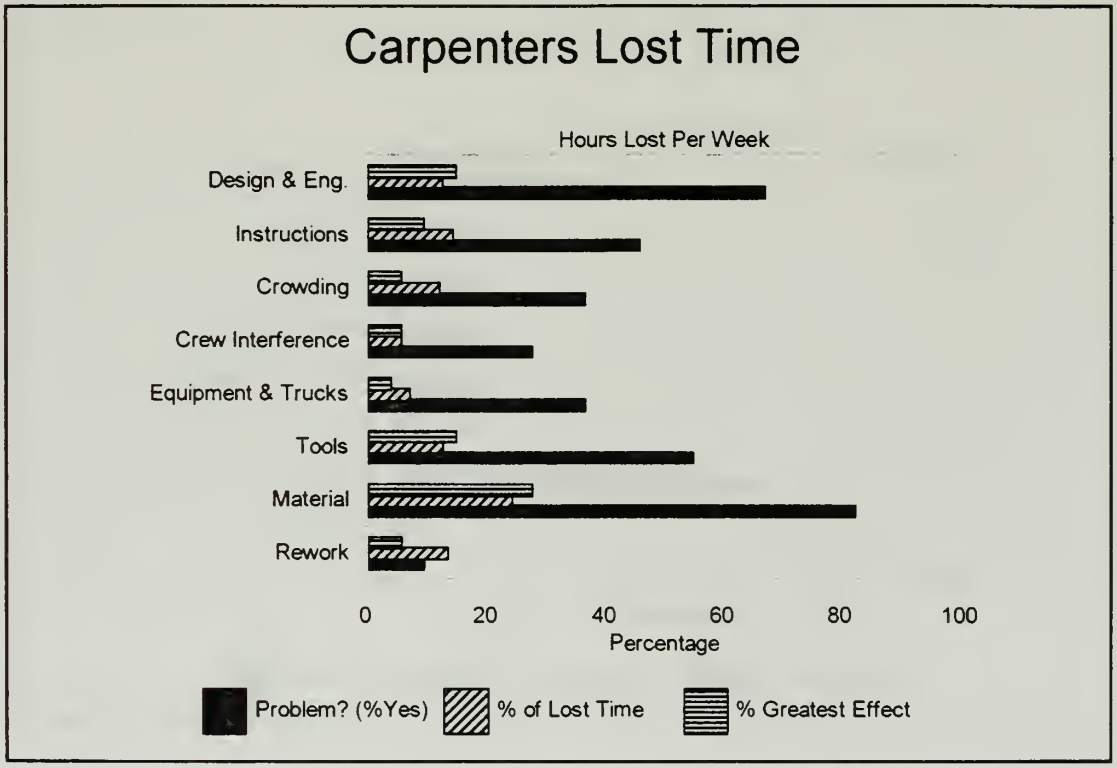


Figure 5.9: Carpenters Lost Time

Most carpenters felt their tool rooms did not have enough new carpenter's tools or pneumatic tools. Equipment and truck availability was not a significant problem for carpenters; 36% stated that their crew had to stop work or move because they did not have the equipment or truck they needed.

5.6 Electricians

Electricians represent 9.3% of the specific work force and 14.6% of all crafts surveyed. Six of the 46 craftsmen surveyed were electricians. Figure 5.10 shows the lost time graph for electricians.

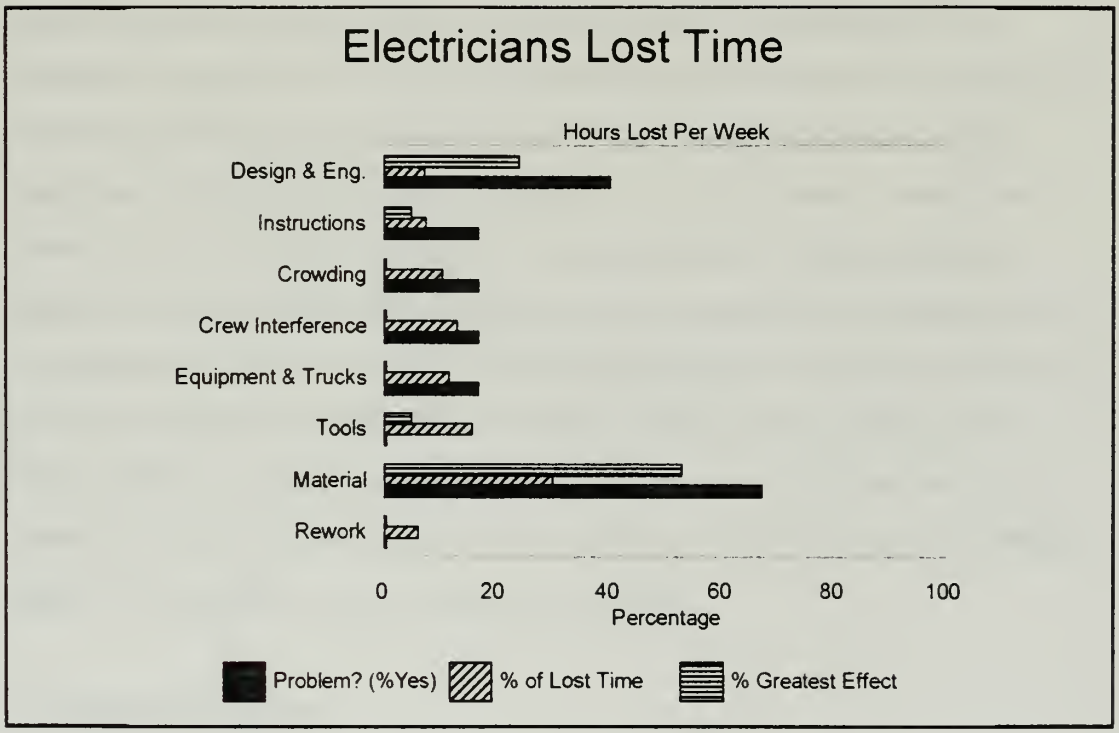


Figure 5.10: Electricians Lost Time

The top two problem areas were the same as the top two problem areas for the survey report for all zones, Zone 1 sort, and Carpenter sort. They were materials (5 lost hours per week per man) and design/engineering/P&E (1.2 hours lost per week per man). Instructions, crowding, crew interference, and equipment and truck problems tied for the third place problem area (17% of electricians surveyed). Materials and design/engineering/P&E received respective problem area scores of 67% and 40%.

For an average 40-hour work week, each electrician lost 16.9 hours due to the productivity inhibiting factors studied in the survey. Although all six electricians surveyed answered "no" to question 15 ("Does your crew often have to stop and wait or move to another spot because you do not have the tools you need?"), they stated that they lose an average 2.6 hours a week as a result of tool problems. This information is misleading, due to the small sample size, and could be the result of one electrician answering the question improperly. From the statistical data and the electricians' comments, there does not appear to be a tool problem. Twenty-nine percent of the electricians attributed the material problem to vendors delivering materials late, and another 24% assigned the cause to materials not located prior to a job assignment. Thirty-six percent of the electricians credited the design problem to a lack of coordination between engineers, P&Es, and shops. Poor drawings and engineers/P&E's unfamiliarity with actual job conditions were the next two largest causes (18% of electricians for each). On a positive note, rework and tool problems appear to be negligible or non-existent for electricians.

5.7 Sheetmetal Workers

From a total of 17 sheetmetal workers who perform specific work in the zones, five were surveyed. An alarming statistic based on this survey which requires further

investigation is that 71.4% (28.6 hrs. out of 40 hrs.) of the hours of a typical sheetmetal worker are lost time. Figure 5.11 is the lost time graph for sheetmetal workers. Every sheetmetal worker thought material was a problem area, 80% thought design/engineering/P&E was a problem area, and 60% thought both equipment and trucks and tools were problem areas. Equipment and trucks ranked first in terms of percent lost time with approximately 49% percent of the 28.6 (14 hrs per week) lost hours attributed to equipment and truck problems. Materials ranked second in terms of percent lost time with 21%of the 28.6 (6.1 hrs. per week) lost hours attributed to material problems.

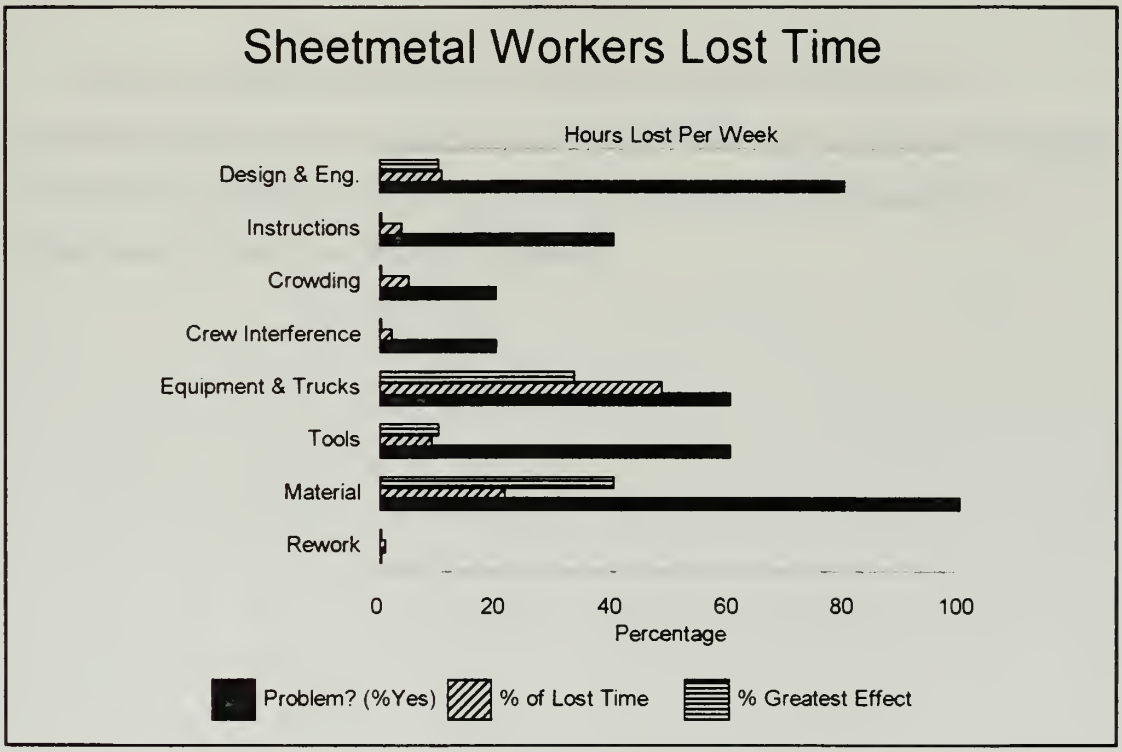


Figure 5.11: Sheetmetal Workers Lost Time

Fifty percent of the sheetmetal workers thought there were not enough trucks and twenty-five percent attributed the problem to broken trucks or equipment. Materials scored highest in the percent greatest effect category with a weighted score of 12 (40%), and equipment and trucks scored second highest with a weighted score of ten (33.33%). The comments section did not provide any specific reasons as to why 14 hours per week per sheet metal worker were lost due to equipment and truck problems. This group needs to be studied in greater depth. A follow-up survey, interviews, or a problem-solving team is warranted immediately.

5.8 Maintenance Workers and Plumbers/Pipefitters

A written summary section is not included for Maintenance Workers or Plumbers/Pipefitters, because their most serious problems are very similar to the other sorts previously analyzed. Figures 5.12 and 5.13 are the lost time graphs for Maintenance Workers and Plumbers/Pipefitters.

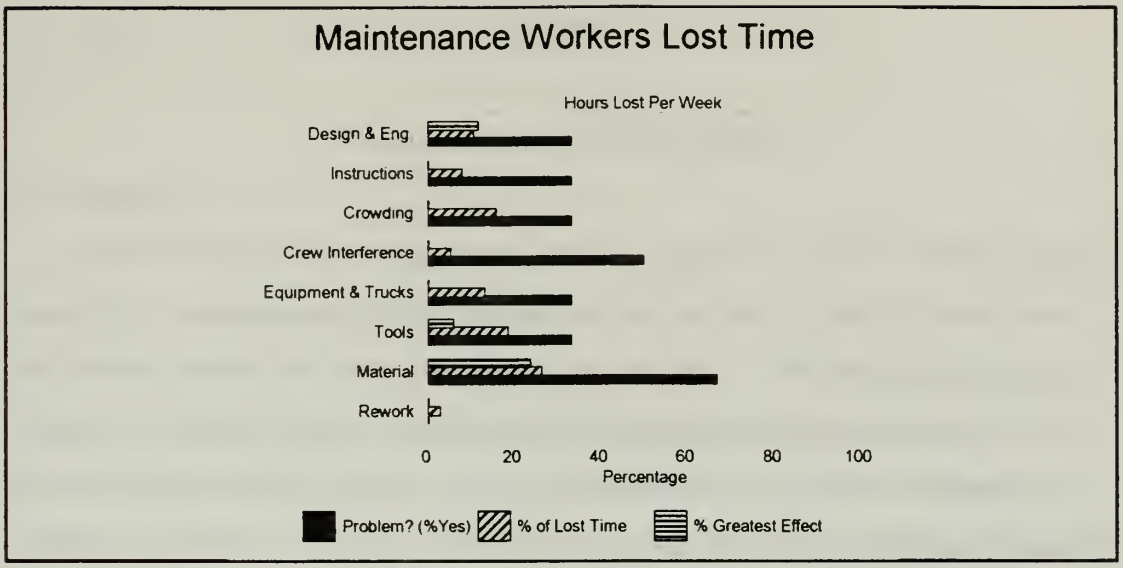


Figure 5.12: Maintenance Workers Lost Time

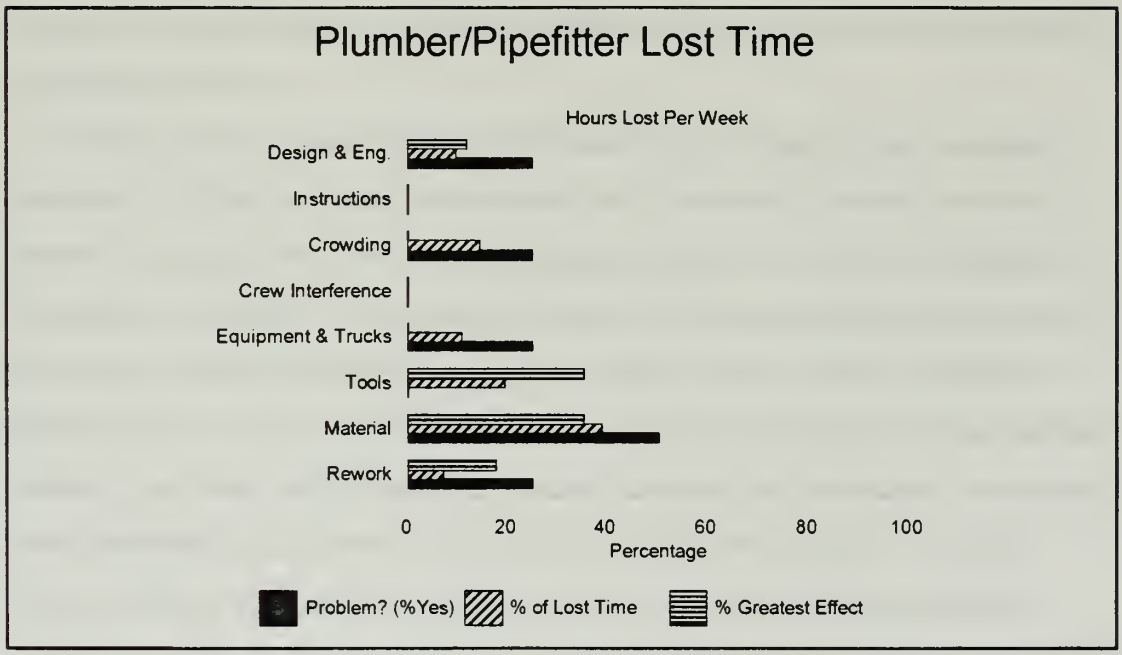


Figure 5.13: Plumbers/Pipefitters Lost Time

Chapter 6

Recommendations and Conclusions

6.1 Materials

As evidenced by all 11 management summary reports (provided to CDR Snyder in June 1996), material availability is the number one problem in terms of journeymen perception, percent lost time, and percent greatest effect. PWC management must correct the material problem immediately. If the problem is purely perception, they need to change that perception. If it is a process problem, they need to change the process. According to the survey, the greatest causes of material problems are that the material is not located prior to job assignment and not ordered with adequate lead time. Although effective communication could--and should-- rectify the problem of material not located prior to job assignment, the author recommends a comprehensive material flow chart analysis to identify bottlenecks which currently exist in the material procurement system.

It is the author's opinion that the PWC material process needs to be completely reengineered. First, the author recommends that all material department personnel located in the zones work for the Zone Manager instead of the Head of the Material Department. Second, it is recommended that the PWC material department adopt the automated electronic material contracting processes currently used at China Lake Weapons Station. This "smart" system uses innovative technology as well as the latest federal procurement regulations/policy adopted to streamline government contracting. More importantly, this system is used universally by private industry. A complete synopsis of the workings and advantages of this system was provided to the PWC Production Officer in March of 1995. LCDR Scott Smith and the author also attended various presentations by Trade Services Company, which illustrated the benefits of electronic commerce including the award of several Indefinite Quantity Construction

Material Contracts. Implementing this system would, undoubtedly, facilitate the reduction in labor rates by eliminating costly overhead material charges.

6.2 Design/Engineering/Planning and Estimating

The design/engineering/P&E problem has been a long standing problem. One recommendation may be to assign the P&Es to the shops. This would strengthen P&E ownership and should improve communication between the P&E and the journeymen. It would also stimulate teamwork between the P&E, shop supervisor, and journeymen. In addition, P&Es, shop supervisors, and working leaders should be taught basic critical path scheduling techniques. Common "off the shelf" estimating and scheduling programs should also be procured and utilized. The current system is antiquated and inefficient and cannot be used if the PWC plans to compete with outside contractors. Proper training is critical for this recommendation to work. Many of the PWC's new supervisors are young hard-chargers who strongly desire to change the old paradigms. They are natural leaders who have the ability to be superb managers, however, they need formal training. They need specific construction management training courses that teach them how to plan, organize, staff, direct, control, and monitor their work. The Construction Industry Institute, headquartered in Austin, Texas, offers excellent "short courses" which typically last three to five days and are taught by the University's construction management faculty or other industry experts. These courses are offered in Austin as well as other parts of the country, and if the demand exists, special arrangements can be made to bring the courses to a client's site. For additional information on this matter, contact Dr. Richard Tucker, CEPM Program Leader at The University of Texas at Austin and Director of the Construction Industry Institute. Finally, the Production Officer and each Zone and Assistant Zone Manager should be provided a copy of Howell's book "Productivity

Improvement in Construction." An in-house, informal training program should be developed to discuss and decide which tools and processes described in the book could and should be implemented.

6.3 Tools

The availability of tools appears to be an area where large benefits may occur with minimal effort. Most respondents complained about insufficient tool quantities. One method to determine whether this problem really exists is to develop a "hit list" and record how many and what type of unfilled tool requests occur. This information could then be used to purchase tools in high demand. Another tool room study which could be implemented would be to record the average time it takes a journeyman to obtain a tool from the tool room at a certain time of the day (such as the morning or after lunch). This information could then be used to schedule tool room hours for certain shops, eliminating long tool room lines. Finally, a small tool room committee may be charted to investigate tools used in the private sector to ensure that the PWC tool rooms are outfitted with the latest tools to enhance productivity.

6.4 Vehicles

Due to budget constraints, every zone's vehicle budget will remain constant--or be reduced--in the future. Hence, the total number of vehicles in the zone will decrease, not increase. The first issue the Center must address is the ambiguous and confusing vehicle transportation policy. The author estimates that 50-60% of each zone's equipment budget is for medium to small pick-ups used to transport workers and miscellaneous materials and tools to and from the job site. One possible solution to reduce the exorbitant vehicle budgets would be to require the craftsmen to use their

private vehicles for work purposes, and reimburse them for all mileage associated with work trips. A clear vehicle policy must be established for all classes of work (Recurring, Minor Work, Specific Work, Emergency Service Work, etc.), negotiated with the union, and explicitly presented to the employees. The vehicle issue has existed for years but has now resurfaced and become critical since dollars and vehicles are becoming scarce. The author was a member of the management negotiation team tasked with re-negotiating the labor contract with the local union. The vehicle issue was tabled, but not addressed in the detail that it should have been because of concerns that it would result in negotiation deadlock. Although the management-union negotiations may not have been the proper forum to address this issue, the author believes this issue needs to be addressed promptly. The author strongly recommends that the PWC Executive Board task a Quality Management Board to study this problem. Board Membership should include managers/supervisors from various zones, the transportation department, the Union, and possibly the legal department.

6.5 Summary

In summary, PWC San Diego's average lost time per worker per week is twice as great as it should be. Corrective actions should be taken quickly to improve productivity by reducing the average lost time from 20 hours to 10 hours per week per craftsman. High-powered problem solving teams with management representation should be chartered at once to study material, tool, engineering, and equipment/truck problems. In addition, a small Process Action Team (PAT) of sheetmetal workers should be assembled to further investigate and validate the 71.4% lost time figure previously discussed. If these results accurately reflect the entire sheetmetal work force, the team should use the PAT process to discover the root cause and develop

more efficient processes to eliminate lost time and improve worker morale.

Lastly, the author found the E.L Hamm productivity analysis informative and useful. The author wishes he was aware of the study while still assigned to the PWC, rather than after leaving the organization. The study collected much useful data, presented many excellent facts, and made some superb recommendations. Unfortunately, some of the problems identified in the study are still present today. This seems to indicate that the Public Works Center failed to implement any of E.L. Hamm's suggestions. Since existing management is already overextended and in-house formal productivity improvement expertise is virtually non-existent, the author recommends that a similar study to the E.L. Hamm study be commissioned. However, the consultant should be hired to help implement and monitor the program.

Appendices

APPENDIX A

PUBLIC WORKS CENTER SAN DIEGO SURVEY QUESTIONNAIRE

Zone: I._____ II._____ III._____ IV._____ Code 55____

Personal Data (Please do not include your name)

1) What is your trade?

Electrician	_____	Floor Coverer	_____	Carpenter	_____
Sheetmetal	_____	Const. Mechanic	_____	Mason	_____
Pipefitter	_____	Welder	_____	Painter	_____
Plumber	_____	Maint. Worker	_____	_____	_____

2) How long have you been working in your trade?

Number of years:_____

3) How long have you been working for Public Works Center San Diego?

_____years _____months

4) How many hours do you normally work per week? Do not leave blank and base your answer on a 5 day work week.

____hours in_____days each week

5) On average, how many people are in your crew?

Number of Craftsmen:_____

6) What level of tradesmen are you?

Shop Superintendent _____
General Foreman _____
Working Leader _____
Journeyman _____
Apprentice _____

Rework

7) Do you often spend time doing work over?

Yes _____
No _____

8) How many hours per week would you guess you spend doing work over? (Superintendents: estimate hours per week for one craftsman.) Do not leave blank.

Number of hours _____

9) What do you think are your major causes for rework?

Change order	_____	Design error	_____
Prefab error	_____	Field error	_____
Damaged material	_____	Unknown	_____
Coordination/Layout error	_____		

Other; Please explain:_____

10) What do you think could be done to reduce rework?

_____
_____

Materials

11) Do you often have to stop work and wait or move to another spot because you do not have the materials to work with?

Yes _____
No _____

12) How many hours per week would you guess you spend waiting for materials, getting materials, or moving to a different area because of no materials? (Superintendents: estimate hours per week for one craftsman.) Do not leave blank.

Number of hours/week_____

13) In your opinion, why is getting materials to work with a problem?

Material is not located prior to job assignment ....._____

Vendor did not deliver items on time....._____

Too much paperwork for getting material....._____

Inefficient operation in warehouse....._____

Materials are too far away from work area....._____

No proper transporting equipment to move material....._____

Not enough material personnel....._____

No on site storage available....._____

Material was not ordered with adequate lead time....._____

Unknown....._____

Other, explain....._____

14) How do you think materials problems could be improved?

_____

_____

_____

Tools

---

15) Do you often have to stop work and wait or move to another spot because you do not have the tools you need?

Yes _____

No _____

16) How many hours per week would you guess you spend waiting for tools, getting tools, or moving to a different area because of no tools? (Superintendents: estimate hours per week for one craftsman.) Do not leave blank.

Number of hours/week _____

17) In your opinion, why is getting tools to work with a problem?

Tools are not located prior to job assignment....._____

Not enough tools for the size of the work force....._____

Tool was broken during the work....._____

Tool supply is too far from work area ....._____

Other crews hoard tools, but they do not use them....._____

Lost tools are not replaced....._____

Inefficient process in tool room....._____

Tool was not scheduled with enough lead time....._____

18) What specific tools do you have the most trouble getting?

_____
_____
_____
_____

19) What consumable items do you have the most trouble getting (for example drill bits, welding rods, electrical tape)?

_____
_____
_____
_____

20) How do you think problems with tools or consumables can be improved?

_____
_____
_____
_____

Equipment, Trucks

21) Do you often have to stop work and wait or move to another spot because you do not have the equipment or a truck you need?

Yes _____
No _____

22) How many hours per week would you guess you spend waiting for equipment and a truck, getting equipment or a truck, or moving to a different area because of no equipment or truck? (Superintendents: estimate hours per week for one craftsman.) Do not leave blank.

Number of hours/week _____

23) In your opinion, why is getting equipment or a truck to work with a problem?

Truck or equipment had not been arranged prior to job assignment..... _____

Someone else is still using the truck assigned to your crew..... _____

Not enough trucks on site..... _____

Inefficient process to get a truck or equipment..... _____

Equipment was not ordered with enough lead time..... _____

Truck or equipment is broken..... _____

Unknown..... _____

Other, explain..... _____

24) How do you think problems with equipment or trucks could be improved?

_____
_____
_____
_____

Crew Interference

25) Do you often have to stop work and wait or move to another spot because another crew had to work in that area?

Yes _____
No _____

26) How many hours per week would you guess you lose because you are waiting or moving from one spot to another because of another crew? (Superintendents: estimate hours per week for one craftsman.) Do not leave blank.

Number of hours/week _____

27) What trade(s) are most often responsible for this interference?

_____
_____
_____
_____

28) In your opinion, why is interference between crews a problem?

Lack of communication among supervisory personnel _____

No detail scheduling among crews..... _____

Unknown..... _____

Other, explain..... _____

29) How do you think the crew interference problem could be improved?

_____
_____
_____
_____

Overcrowded Work Areas

30) Do you often have to work in such overcrowded conditions that it slows you down from doing work as efficiently as you could have done the work under normal conditions?

Yes _____
No _____

31) How many hours per week would you guess you lose because of overcrowded working conditions? (Superintendents: estimate hours per week for one craftsman.) Do not leave blank.

Number of hours/week _____

32) In your opinion, why are overcrowded work areas a problem?

Extra people assigned to the job....._____

Work area is too small....._____

Lack of coordination among craftsmen....._____

Too many materials laying down and in the way....._____

Work areas are crowded with left trash....._____

Too much equipment laying down and in the way....._____

Too many tools laying down and in the way....._____

Unknown....._____

Other, explain....._____

33) How do you thing the overcrowded work area problem could be improved?

_____

_____

_____

_____

Instructions

---

34) Do you often spend time waiting for someone to give you instructions on what you are supposed to be doing?

Yes _____

No _____

35) How many hours per week would you guess that you spend waiting to get instructions about what you are supposed to be doing? (Superintendents: estimate hours per week for one craftsman.) Do not leave blank.

Number of hours/week _____

36) In your opinion, why are instruction delays a problem?

Zone Manager....._____
Assistant Zone Manager....._____
General foreman....._____
Working Leader....._____
Superintendent....._____
Unknown....._____
Other, explain....._____

37) How do you think the instruction delay problem could be improved?

_____
_____
_____
_____

Design Interpretation and Additional Planning/Engineering Information

38) Do you often spend time waiting for design interpretation or additional planning/engineering information?

Yes _____
No _____

39) How many hours per week would you guess you spend waiting for design interpretation or additional engineering information, or moving to alternative work because of these problems? (Superintendents: estimate hours per week for one craftsman.) Do not leave blank.

Number of hours/week _____

40) In your opinion, why are design/planning interpretation and additional engineering information delays a problem?

Poor drawings/sketeches....._____

Poor specifications/Job Plans....._____

Lack of coordination between engineers/p&E's and shops._____

Complex process to get approval for needed change and

information....._____

Engineers/P&E's are not familiar with actual job

conditions....._____

Indecision of engineers/P&E's....._____

Unknown....._____

Other, explain....._____

41) How do you think the design interpretation and additional information problem could be improved?

_____
_____
_____
_____
_____

Summary

42) How many hours per day (on the average) do you think you spend actively engaged in physical work, whether rework or not. This would be your total hours per day minus all time spent for the problems listed above, any personal time or for any reason not listed above? (Superintendents: estimate hours per day for one craftsman.) Do not leave blank.

Number of hours/day active _____
"hands on work"

On what length of day are you basing your estimate of active work?

_____hour day

43) Please indicate whether or not each of the subjects listed below is an important and common problem in completing specific work on shedule and within budget. (Be sure to check one of the columns for each item unless you have no opinion about that item.)

	Problem	Not a Problem
a. Rework	_____	_____
b. Materials	_____	_____
c. Tools	_____	_____
d. Equipment or trucks	_____	_____
e. Other crews not finished	_____	_____
f. Overcrowded work areas	_____	_____
g. Waiting for instructions	_____	_____
h. Waiting for design interpretation and additional engr./P&E info.	_____	_____
i. Absenteeism/Tardiness	_____	_____
j. Turnover	_____	_____
k. Omitted		
l. Quality of work	_____	_____
m. Quality of supervision	_____	_____
n. Amount of supervision	_____	_____
o. Safety	_____	_____
p. Extended breaks/early quitting time	_____	_____
q. Omitted		
r. Personnel transportation	_____	_____

44) From the subjects listed above, which problem, if improved, would have the greatest effect on the job? (List the appropriate letter from question #43.)

Letter _____

45) Which problem, if solved, would have the second greatest effect on the job? (List the appropriate letter from question #43.)

Letter _____

46) Which problem, if solved, would have the third greatest effect on the job? (List the appropriate letter from question #43.)

Letter _____

47) Omitted

48) What do you like most about your job?

_____
_____
_____
_____
_____

49) What do you like least, or would most like to change about your job?

_____
_____
_____
_____
_____

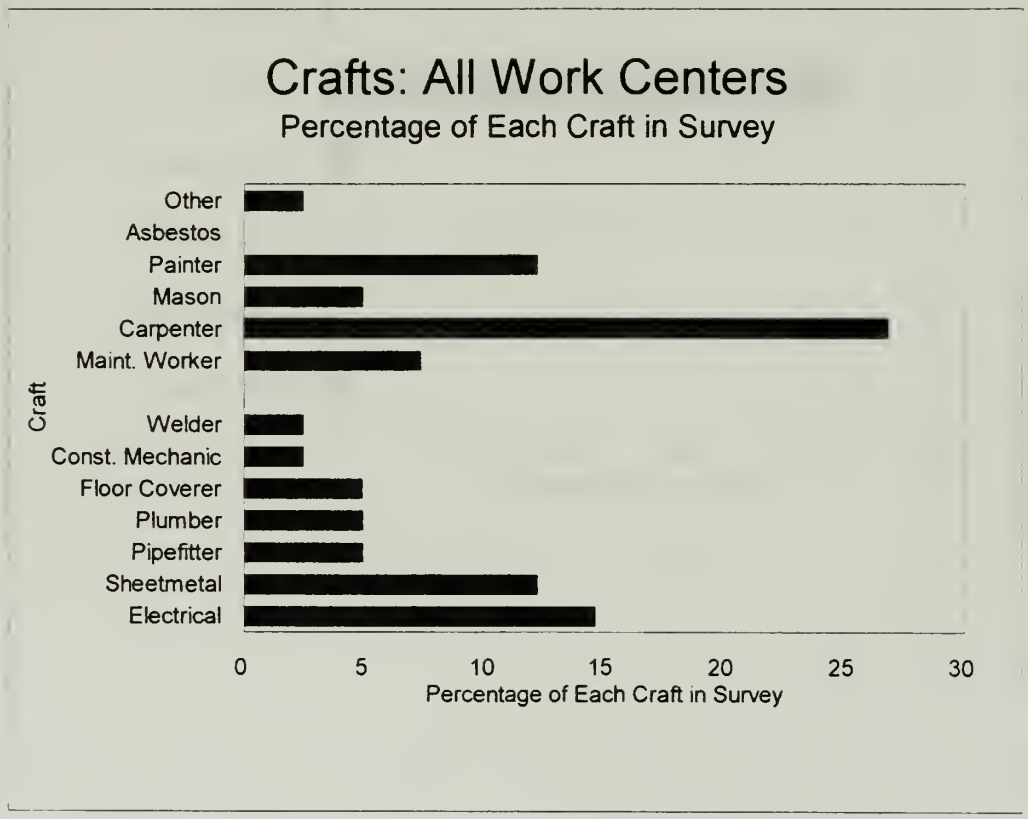
50) Do you have any other comments or suggestions?

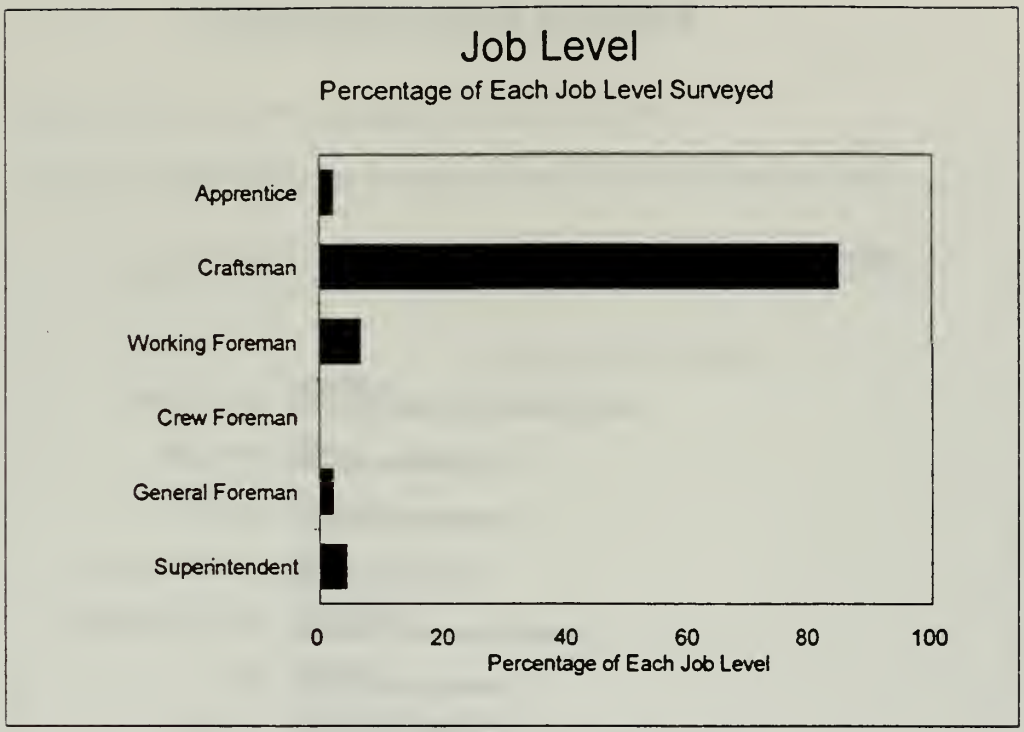
_____
_____
_____
_____
_____

APPENDIX B

Management Summary Report: All Work Centers

This survey includes 46 people working an average of 40.0 hours per week in a 5.0 day work week. The average crew size is 2.6 people.

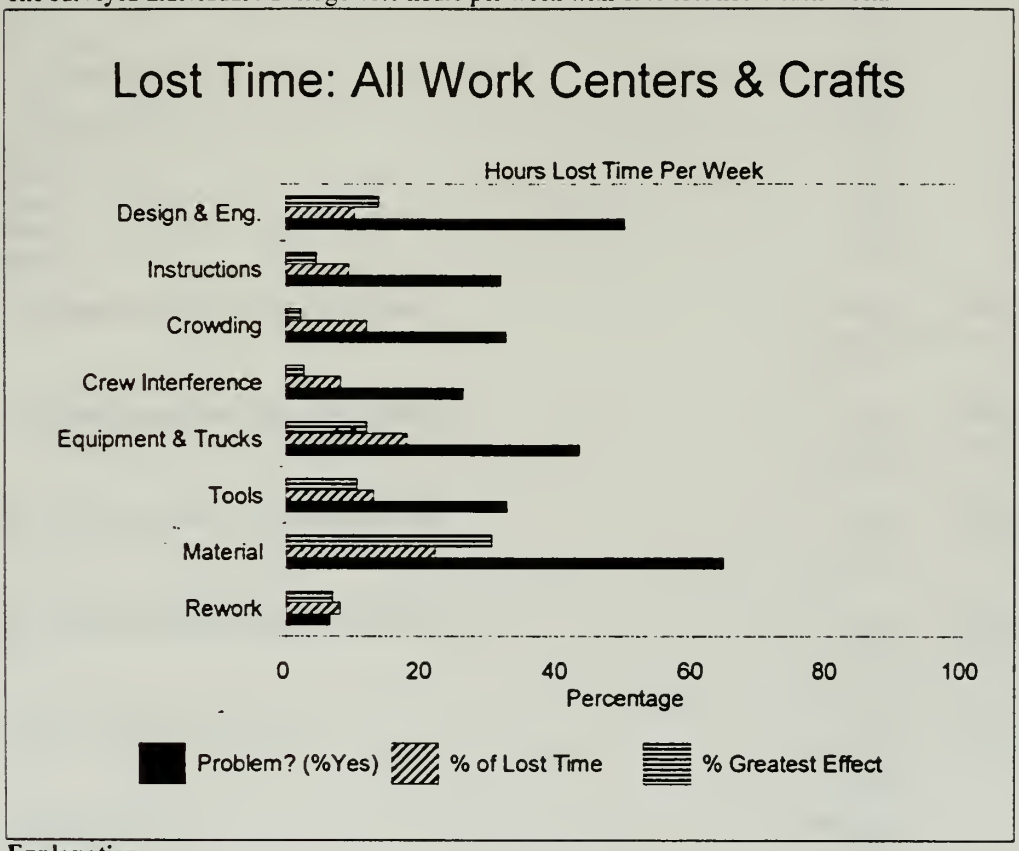



Job Level
Percentage of Each Job Level Surveyed
Apprentice
Craftsman
Working Foreman
Crew Foreman
General Foreman
Superintendent
0
20
40
60
80
100
Percentage of Each Job Level

Lost Hours of Work Per Week

Based on this survey, 49.4% of the hours on the job are lost time.

The surveyed individual's average 40.0 hours per week with 19.8 lost hours each week.



Explanation:

Problem? (%Yes)
Percentage of people who indicated that this factor is a problem.

% of Lost Time
Based on the lost hours each week for each problem shown here.

% Greatest Effect
Based on the weighted rankings of the problems indicated to have the three greatest effects.

Survey Summary Detail: All Work Centers

Personal Data

1) What is your trade?	Number	%
Electrical	6	14.63
Sheetmetal	5	12.20
Pipefitter	2	4.88
Plumber	2	4.88
Floor Coverer	2	4.88
Const. Mechanic	1	2.44
Welder	1	2.44
Maintenance Worker	3	7.32
Carpenter	11	26.83
Mason	2	4.88
Painter	5	12.20
Asbestos	0	0.00
Other	1	2.44

2) How long have you been working in your trade?	Avg.	Std. Dev.
	18.33	9.48

3) How long have you been working for this company?	Avg.	Std. Dev.
	8.69	6.85

4a) How many hours do you normally work per week?	Avg.	Std. Dev.
	40.00	0.00

4b) How many days do you normally work per week?	Avg.	Std. Dev.
	5.00	0.00

5) How many people are in your crew?	Avg.	Std. Dev.
	2.58	1.20

6) What is your job level?	Number	%
Superintendent	2	4.35
General Foreman	1	2.17
Crew Foreman	0	0.00
Working Foreman	3	6.52
Craftsman	39	84.78
Apprentice	1	2.17

Rework

7) Does your crew often spend time doing work over?	Number	%
Yes	3	6.52
No	43	93.48

8) How many hours per week would you guess you spend doing work over?	Avg.	Std. Dev.
	1.57	2.75
Percent Loss Per Week	3.91%	

9) What do you think are your major causes for rework?	Number	%
Change order	13	27.66
Prefab error	4	8.51
Damaged material	1	2.13
Coordination/Layout error	11	23.40
Design error	8	17.02
Field error	5	10.64
Unknown	5	10.64

Materials

11) Does your crew often have to stop work and wait or move to another spot because they do not have the materials to work with?	Number	%
Yes	29	64.44
No	16	35.56

12) How many hours per week would you guess you spend waiting for materials, getting materials, or moving to a different area because of no materials?	Avg.	Std. Dev.
	4.35	2.98
Percent Loss Per Week	10.86%	

13) In your opinion, why is getting materials to work with a problem?	Number	%
Material is not located prior to job assignment	23	22.55
Vendor did not deliver items on time	18	17.65
Too much paperwork for getting material	9	8.82
Inefficient operation in warehouse	8	7.84
Materials are too far away from work area	6	5.88
No proper transporting equip to move material	9	8.82
Not enough material personnel	1	0.98
No on site storage available	8	7.84
Material was not ordered with adequate lead time	17	16.67
Unknown	3	2.94

Tools

15) Does your crew often have to stop work and wait or move to another spot because you do not have the tools you need?	Number	%
Yes	15	32.61
No	31	67.39

16) How many hours per week would you guess you spend waiting for tools, getting tools, or moving to a different area because of no tools?	Avg.	Std. Dev.
	2.54	2.43
Percent Loss Per Week	6.35%	

17) In your opinion, why is getting tools to work with a problem?	Number	%
Tools are not located prior to job assignment	10	13.89
Not enough tools for the size of the work force	17	23.61
Tool was broken during the work	6	8.33
Tool supply is tool far from work area	9	12.50
Other crews hoard tools,but they do not use them	16	22.22
Lost tools are not replaced	5	6.94
Inefficient process in tool room	5	6.94
Tool was not scheduled with enough lead time	4	5.56

Equipment, Trucks

21) Does your crew often have to stop work and wait or move to another spot because they do not have the equipment or a truck they need?	Number	%
Yes	19	43.18
No	25	56.82

22) How many hours per week would you guess your crew spends waiting for equipment or a truck, getting equipment or a truck, or moving to a different area because of a lack of equipment or truck?	Avg.	Std. Dev.
	3.51	6.88
Percent Loss Per Week	8.76%	

23) In your opinion, why is getting equipment or a truck to work with a problem?	Number	%
Truck or equipment had not been arranged prior to job assignment	17	25.37
Someone else is still using the truck assigned to your crew	7	10.45
Not enough trucks on site	17	25.37
Inefficient process to get a truck or equipment	7	10.45
Equipment was not ordered with enough lead time	9	13.43
Truck or equipment is broken	9	13.43
Hoist time not scheduled properly	0	0.00
Unknown	1	1.49

Crew Interference

25) Do you often have to stop work and wait or move to another spot because another crew had to work in that area?	Number	%
Yes	11	26.19
No	31	73.81

26) How many hours per week would you guess you lose because you are waiting or moving from one spot to another because of another crew?	Avg.	Std. Dev.
	1.61	2.09
Percent Loss Per Week	4.03%	

28) In your opinion, why is interference between crews a problem?	Number	%
Lack of communication among supervisory personnel	9	26.47
No detail scheduling among crews	16	47.06
Unknown	9	26.47

Overcrowded Work Areas

30) Does your crew often have to work in such overcrowded conditions that it slows them down from doing work as efficiently as they could have done the work under normal conditions?	Number	%
Yes	14	32.56
No	29	67.44

31) How many hours per week would you guess you lose because of overcrowded working conditions?	Avg.	Std. Dev.
	2.36	3.08
Percent Loss Per Week	5.90%	

32) In your opinion, why are overcrowded work areas a problem?	Number	%
Extra people assigned to the job	8	14.55
Work area is too small	7	12.73
Lack of coordination among craftsmen	9	16.36
Too many materials laying down and in the way	8	14.55
Work areas are crowded with left trash	8	14.55
Too much equipment laying down and in the way	5	9.09
Too many tools laying down and in the way	4	7.27
Unknown	6	10.91

Instructions

34) Do you often spend time waiting for someone to give you instructions on what you are supposed to be doing?	Number	%
Yes	14	31.82
No	30	68.18

35) How many hours per week would you guess that you spend waiting to get instructions about what you are supposed to be doing?	Avg.	Std. Dev.
	1.84	2.28
Percent Loss Per Week	4.60%	

36) In your opinion, why are instruction delays a problem?	Number	%
Home office	0	0.00
Field engineer	0	0.00
General foreman	3	13.04
Foreman	3	13.04
Superintendent	4	17.39
General contractor	0	0.00
Unknown	13	56.52

Design Interpretation and Additional Engineering Information

38) Do you often spend time waiting for design interpretation or additional engineering information?	Number	%
Yes	21	50.00
No	21	50.00

39) How many hours per week would you guess you spend waiting for design interpretation or additional engineering information?	Avg.	Std. Dev.
	2.00	2.49
Percent Loss Per Week	5.00%	

40) In your opinion, why are design interpretation and additional engineering information delays a problem?	Number	%
Poor drawing	15	17.24
Poor specification	14	16.09
Lack of coordination between engineers & contractors	22	25.29
Complex process to get approval for needed change and information	6	6.90
Engineers are not familiar with actual job conditions	19	21.84
Indecision of engineers	7	8.05
Unknown	4	4.60

Summary

42) How many hours per day (on the average) do you think you spend actively engaged in physical work? This would be your total hours hours per day minus all time spent for the problems listed above, and any personal time for any reason not listed above.	Avg.	Std. Dev.
	6.36	0.90
On what length of day are you basing your estimate of active work?	8.02	0.15

43) Please indicate whether or not each of the subjects listed below is an important problem on this job.	Number	%
a) Rework	9	5.06
b) Materials	35	19.66
c) Tools	18	10.11
d) Equipment or trucks	20	11.24
e) Other crews not finished	13	7.30
f) Overcrowded work areas	13	7.30
g) Waiting for instructions	14	7.87
h) Waiting for design interpretation and additional engineering info	14	7.87
i) Absenteeism/Tardiness	5	2.81
j) Turnover	2	1.12
k) Parking and road access	0	0.00
l) Quality of work	7	3.93
m) Quality of supervision	7	3.93
n) Amount of supervision	9	5.06
o) Safety	0	0.00
p) Extended breaks/early quitting time	5	2.81
q) Hoist time	0	0.00
r) Personnel transportation	7	3.93

44-46) From the subjects list above, which problem if improved would have the greatest effect on the job? Summary of first, second, and third greatest effects with the highest score indicating the greatest effect.	Score	%
a) Rework	15	6.88
b) Materials	66	30.28
c) Tools	23	10.55
d) Equipment or trucks	26	11.93
e) Other crews not finished	6	2.75
f) Overcrowded work areas	5	2.29
g) Waiting for instructions	10	4.59
h) Waiting for design interpretation and additional engineering info	30	13.76
i) Absenteeism/Tardiness	6	2.75
j) Turnover	0	0.00
k) Parking and road access	1	0.46
l) Quality of work	6	2.75
m) Quality of supervision	11	5.05
n) Amount of supervision	8	3.67
o) Safety	0	0.00
p) Extended breaks/early quitting time	0	0.00
q) Hoist time	0	0.00

JOURNEYMAN REWORK COMMENTS

READ PLANS AND JOB SPECS CAREFULLY & THOUGH ESPECIALLY THAN WHICH PERTAINS TO YOUR TRADE.

GOOD FIELD COORDINATION/COMMUNICATION BETWEEN SUPERVISORS AND TRADESMAN BEFORE HAND.

MORE SPECIFIC INST. FROM P & E ON JOB PACKAGE.

NOTHING THIS IS CUSTOMER ERROR.

HAVING A FIELD SUPERINTENDENT WHO HAS COMPLETE KNOWLEDGE OF YOUR PROJECTS WHO CAN DIRECT CRAFTSMEN IN THE SCOPE OF THE JOB.

MORE TRAINING ON THE NEWER PRODUCTS

CAREFUL PLANNING & ESTIMATING, REALISTIC TIME FRAMES.

ONE JOURNEYMAN FROM START TO FINISH.

BETTER CRAFTSMANSHIP

BETTER PLANNING & ESTIMATING

PROPER LAYOUT TALK TO THE JOURNEYMEN PROPER MATERIALS AND AN ESTIMATED PROPER TIME (HOURS) TO COMPLETE THE TASK.

HIRE QUALIFIED WORKERS

BETTER QUALIFIED JOURNEYMEN

NONE THERE IS VERY LITTLE REWORK, MAYBE ONCE A MONTH.

BETTER PLANNING

STICK TO ORIGINAL PLAN

HAVE WORK INSPECTED BY COMPETENT SUPERVISOR OR COMPETENT TRADESMEN BY SAME TRADE DISCIPLINE.

BETTER PLANNING OR HAVE JOURNEYMAN PLAN HIS/HER OWN WORK.

HAVE MORE TRADESMEN TO CUSTOMER TALK ONLY ORDER AND WORK WHAT CUSTOMER WANTS WITHOUT REDOING OLD JOB PLANS AND PARTS UNNECESSARY FROM OLD JOB PACKAGES.

MAKE SURE JOB IS PROPERLY PLANNED BEFORE STARTING AND CAUTION IS USED WHEN DELIVERING MATERIALS.

FIRST ALLOW THE CUSTOMER TO PLAN THE JOB OR GIVE INPUT TO THE JOURNEYMEN AND ELIMINATE PLANNER & ESTIMATORS.

MORE TIME USED FOR DETAILING AND COORDINATE WITH OTHER CRAFTSMEN.

NOTHING

KNOW YOUR WHOLE JOB IN DETAIL

WAIT UNIT WE GET MATERIAL BEFORE WE START JOB.

THROUGH PLANNING, QUALITY WORKMANSHIP

PUT EVERYTHING IN WRITING. THEN IF WE HAVE A CHANGE ORDER OR COORDINATION PROBLEM, IT IS DOCUMENTED & THE JOURNEYMAN HAS A LEG TO STAND ON. HOWEVER IF THE JOURNEYMAN BOTCHES HIS JOB HE CANNOT POINT A FINGER EITHER.

DO IT RIGHT THE FIRST TIME.

SEND CARPENTER FROM CODE 552 THE FIRST TIME.

QUICKER SUPPLY

EMPLOYEES TAKE PRIDE IN ONE'S OWN WORK

GET RID OF THE ATTITUDES FIRE THEM

MORE TALK

MORE INFO FROM CUSTOMER BETTER COMMUNICATION

JOURNEYMEN MATERIAL COMMENTS

NOT MUCH

COMPLETE UPGRADE OF ALL EQUIP (SHOP) AND MISC. ITEMS REQUIRE TO DO THE MIN. FINISH WOOD WORK IN THIS SHOP.

BUY MORE TOOLS DO NOT LET TOOLS STAY CHECKED TO PERSON FOR SUCH A LONG LENGTH OF TIME.

HAVE A MEETING WITH MECHANICS, SUPERVISORS & LT. DISCUSS WHAT ITEMS ARE NEEDED MOST & CONTACT SHOP STORES OR TOOL ROOM TO MAKE CHANGES.

THESE ITEMS CAN BE BOUGHT THRU CREDIT CARD

HAVE A LARGER STOCK

I THINK PWC SHOULD SET EACH TRADE WITH TWO OR MORE PEOPLE UP WITH PROPER TRUCK, TOOLS AND CONSUMABLES AND MAKE HIM OR HER RESPONSIBLE FOR THE TOOLS ASSIGNED TO THAT TRADESMAN TRUCK.

ORDER MORE

YES, GET JOURNEYMEN TO LIST MOST USED ITEMS SUBMIT REPORT & CARRY ON HAND IN STORE

PRIOR KNOWLEDGE OF WORK LOAD SO PROPER TOOLS CAN BE CHECKED OUT AN TESTED BEFORE START OF JOB.

BY THE USE OF A ROVING STEP VAN FULLY EQUIPPED WITH ALL BASIC POWER TOOLS EXTENSION CORDS AND EXPENDABLE ITEMS, DRILL BITS, EAR PLUGS, DUST MASK.

DUST MASKS SHOULD BE AVAILABLE TO ALL EMPLOYEES NOT JUST THOSE W/A FIT CARD. AN EMPLOYEE IS GOING TO DO THE WORK IF THEY HAVE THE MASK OR NOT.

I UNDERSTAND TOOLS ARE A LIMITED BUDGET, BUT WITH CONSUMABLES ALWAYS REORDER WHEN YOUR ARE AT HALF STOP, WITH ITEMS COMMON, THEY WILL ALWAYS MOVE.

SURVEY THE TOOLS IN THE TOOL ROOM AND FIND OUT WHAT NEEDS TO BE REPLACED ALLOT OF TOOLS ARE UNSAFE FOR USE.

ISSUE EACH CRAFT JOURNEYMAN NEW TOOLS AND LET HE OR SHE TO BE ACCOUNTABLE FOR ITS CONDITION. ALSO HAVE CONSUMABLES SEPARATED FROM TOOL SYSTEM.

PLAN AHEAD

PRIOR PLANNING PREVENTS PISS-POOR PERFORMANCE

STOCK MORE ITEMS

CODE 552 NEEDS THEIR OWN TOOL ROOM. ASK SUPERVISORS FOR LISTS OF TOOL WE NEED MORE OF UPDATED AT CURRANT TOOL ROOMS.

ALLOW EMPLOYEES TO USE OWN POWER TOOLS

PUT A PEB IN THE TOOL/SHOP STORES AREA AND KEEP IT UP.

MORE DONE TO P & E THESE JOBS. THIS END IS VERY WEAK. IF WE NEED MORE P & E'S, THEN HIRE SOME. IF IT IS QUITE POSSIBLE THE WORK LOAD IS TOO GREAT FOR ONLY TWO MEN.

KEEP SHOP STORES STOCKED BETTER.

RESTRUCTURE CODE 800

GET MORE PEOPLE TRAINED FOR CREDIT CARD PURCHASES

BETTER RESPONSE

CORPORATION BETWEEN SUPERVISOR AND EMPLOYEES

STORE A FEW MORE ITEMS HERE THAT WE USE IN THE HOSPITAL. SPEED UP DELIVERY OF ITEMS FROM VENDOR TO OUR LOADING DOCK.

JOURNEYMEN TOOL COMMENTS

NOT MUCH

COMPLETE UPGRADE OF ALL EQUIP (SHOP) AND MISC. ITEMS REQUIRE TO DO THE MIN. FINISH WOOD WORK IN THIS SHOP.

BUY MORE TOOLS DO NOT LET TOOLS STAY CHECKED TO PERSON FOR SUCH A LONG LENGTH OF TIME.

HAVE A MEETING WITH MECHANICS, SUPERVISORS & LT. DISCUSS WHAT ITEMS ARE NEEDED MOST & CONTACT SHOP STORES OR TOOL ROOM TO MAKE CHANGES.

THESE ITEMS CAN BE BOUGHT THRU CREDIT CARD

HAVE A LARGER STOCK

I THINK PWC SHOULD SET EACH TRADE WITH TWO OR MORE PEOPLE UP WITH PROPER TRUCK, TOOLS AND CONSUMABLES AND MAKE HIM OR HER RESPONSIBLE FOR THE TOOLS ASSIGNED TO THAT TRADESMAN TRUCK.

ORDER MORE

YES, GET JOURNEYMEN TO LIST MOST USED ITEMS SUBMIT REPORT & CARRY ON HAND IN STORE

PRIOR KNOWLEDGE OF WORK LOAD SO PROPER TOOLS CAN BE CHECKED OUT AN TESTED BEFORE START OF JOB.

BY THE USE OF A ROVING STEP VAN FULLY EQUIPPED WITH ALL BASIC POWER TOOLS EXTENSION CORDS AND EXPENDABLE ITEMS, DRILL BITS, EAR PLUGS, DUST MASK.

DUST MASKS SHOULD BE AVAILABLE TO ALL EMPLOYEES NOT JUST THOSE W/A FIT CARD. AN EMPLOYEE IS GOING TO DO THE WORK IF THEY HAVE THE MASK OR NOT.

I UNDERSTAND TOOLS ARE A LIMITED BUDGET, BUT WITH CONSUMABLES ALWAYS REORDER WHEN YOUR ARE AT HALF STOP, WITH ITEMS COMMON, THEY WILL ALWAYS MOVE.

SURVEY THE TOOLS IN THE TOOL ROOM AND FIND OUT WHAT NEEDS TO BE REPLACED ALLOT OF TOOLS ARE UNSAFE FOR USE.

ISSUE EACH CRAFT JOURNEYMAN NEW TOOLS AND LET HE OR SHE TO BE ACCOUNTABLE FOR ITS CONDITION. ALSO HAVE CONSUMABLES SEPARATED FROM TOOL SYSTEM.

PLAN AHEAD

PRIOR PLANNING PREVENTS PISS-POOR PERFORMANCE

STOCK MORE ITEMS

CODE 552 NEEDS THEIR OWN TOOL ROOM. ASK SUPERVISORS FOR LISTS OF TOOL WE NEED MORE OF UPDATED AT CURRANT TOOL ROOMS.

ALLOW EMPLOYEES TO USE OWN POWER TOOLS

PUT A PEB IN THE TOOL/SHOP STORES AREA AND KEEP IT UP.

JOURNEYMEN EQUIPMENT/TRUCK COMMENTS

SHOULD COORDINATE W/JOURNEY MEN THE SPECIFIC SIZE, 20FT, 30FT ETC. GAS OR ELECTRIC WHOEVER IS ORDERING EQUIPMENT.

MATERIAL PERSON MAKES DAILY VISITS TO LARGE PROJECTS W/P.V. TRUCK ASKS THE WORKERS WHAT IS NEEDED ON MATERIAL REQUEST LISTS SIGNED BY REQUESTER AT JOB SITE.

HAVE TOOLS NEEDED FROM MAIN TOOL ROOM BROUGHT OVER TO JOB SITE IN A MORE TIMELY MANNER.

GET MORE SPARE KEYS ; KEYS ARE ALWAYS MISSING. ALSO GET MORE TRUCKS.

FORKLIFT MOST OF THE TIME OUT OF FUEL (GET 1 OR 2 MORE FORKLIFTS)

TO PROVIDE ANOTHER SIGN MAKER IN THE SIGN SHOP.

ONE TRUCK PER 2 MEN.

HAVE MORE AVAILABLE.

ASSIGN A TRUCK TO EVERY TWO PEOPLE THAT WAY WE CAN KEEP THE TRUCKS STOCKED WITH WHAT WE NEED.

INCREASE THE NUMBER AVAILABLE.

SIMPLY BY PLACING MORE TRUCKS AND EQUIPMENT WITHIN THE BUDGET. THE WORKFORCE KEEPS INCREASING ALONG WITH THE WORK ITSELF, BUT EVERYTHING ELSE REMAINS THE SAME. THERE CANT BE IMPROVEMENT UNTIL ALONG WITH THE HIRING AND WORK LOAD THAT A BUDGET IS ADDED TO COMPENSATE EVERYTHING THAT IS REQUIRED TO REACH THE GOAL.

GET MORE TRUCKS FOR THE JOURNEYMEN, I LOSE MANY HOURS PER JOB BECAUSE OF THIS.

MORE FLAT BEDS

SAME ANSWER AS LAST QUESTION

PURCHASE OR LEASE WORKING VANS COMPLETE W/LADDER RACK TOOLS & HARDWARE BINS & A VISE TO ACCOMMODATE THE NEEDS TO COMPLETE JOB ON TIME BASED ON PREPAREDNESS. ESSENTIALLY ELIMINATING UNNECESSARY DRIVING TIME

HAVE EQUIPMENT ARRANGED AND RESERVED AHEAD OF JOB START.

PAIR JOURNEYMEN WHEN POSSIBLE, FOR 2 MAN JOBS.

MORE EQUIPMENT AND VEHICLES AND SCHEDULE THEM BETTER.

PROVIDE MORE TRUCKS SUCH AS A EXTRA DUMP TRUCK AND EXTRA OR MORE THAN ONE STAKE TRUCK.

WE COULD USE A BUCKET TRUCK IN EACH CODE

PLAN AHEAD

I USE MY TRUCK ON THE JOB.

BUY SOME FOR THIS CODE.

LET US TAKE OUR TRUCKS TO LUNCH.

I HAVE NOT HAD THESE PROBLEMS

LARGER STOCK IN TOOL ROOM

GET MORE OF THE PROPER TYPE SCOOTERS OR CARTS, SO EVERYONE WHO NEEDS A SCOOTER WILL HAVE ONE.

JOURNEYMEN CREW INTERFERENCE COMMENTS

SCHEDULING. EMPHASIZE CRITICAL PATH CHARTS ON PAPER AMONG TRADES INVOLVED. SORT OF LIKE A

CONSULTING WITH CARPENTERS BEFORE BRINGING ON PAINT CREW.

SUPERVISOR SHOULD TALK WITH ALL PEOPLE TO BE AT JOB SITE TO MAKE WORK FLOW BETTER.

NOT A MAJOR PROBLEM

SUPERVISORS SHOULD MAKE SURE THE SPACE IS READY BEFORE SENDING CREW.

BY HAVING A FIELD SUPERINTENDENT

HAVE WORK LEADERS ON EACH JOB.

MORE ACCURATE SUPERVISION.

BETTER PLANNING AND MATERIALS ORDERED ON TIME.

BETTER PLANNING

SIMPLY BY PROPER SUPERVISION INSTEAD OF DUMPING PEOPLE ON JOBS BECAUSE YOU HAVE NO PLACE

MORE COMMUNICATION

SCHEDULING

COORDINATE WORK STEP BY STEP BY TRADE DISCIPLINE UNTIL COMPLETE,REGARDLESS OF NEW JOBS CO

HAVE THE SUPERVISOR PLAN PROPER PERSONNEL AT RIGHT TIME SO ALL TRADES CAN WORK TOGETHER (

HAVE A PRE JOB CONFERENCE WITH SUPERVISION AND CUSTOMER.

PLAN AHEAD

BETTER SCHEDULES

IN THIS CODE ALL CREWS INTERFACE QUITE WELL.

PERHAPS WORK LEADER WOULD?

MORE CORPORATION BETWEEN SUPERVISORS AND EMPLOYEES

JOURNEYMEN OVERCROWDING COMMENTS

KEEP THE AREA CLEAN AND PICKED UP.

MECHANICS NEED TO HAVE BETTER HOUSEKEEPING PRACTICES. MOST OF THEM ARE SLOBS.

EVERY TRADE SHOULD CLEAN UP AFTER WORK FINISH.

PROVIDE A LARGER WORK AREA, PROVIDE PROPER STORAGE SPACE AND BUILD LARGER EASELS TO WORK ON.

COORDINATING

HAVE WORK LEADERS.

GET JOBS GOING EARLIER SO THE PUSH AT THE END IS NOT SO BAD.

PROPER CLEAN UP

BETTER PLANNING

BETTER PLANNING BY PLANNERS AND FOREMAN

BY PROPER SUPERVISION

COMMUNICATION

CLEAN UP CONSTANTLY AS YOU GO KEEP MATERIAL UNDER CONTROL, KEEP AWARE OF OTHER PEOPLE AND TRADES IN WORK AREA.

COORDINATE PROPER ORDER FOR CRAFTSMEN TO DO THEIR RESPECTED TASKS.

COORDINATE JOB FOR CUSTOMER OFF FRIDAY.

PLAN AHEAD

I CANT SEE A PROBLEM WITH OVER CROWDEDNESS

I DON'T HAVE A PROBLEM WITH IT.

COORDINATE START OF JOB W/CUSTOMERS AND HAVE AREA CLEARED

JOURNEYMEN INSTRUCTION COMMENTS

JOURNEYMEN WHO GO TO PRECON SHOULD BE JOURNEYMEN ASSIGNED TO DOING WORK VERY OFTEN JOURNEYMEN WORKING DID NOT ATTEND PRECON.

JOB SITE VISITS MORE OFTEN BY SUPERVISORS.

SUPERVISOR SHOULD MAKE ARRANGEMENT WITH CUSTOMER BEFORE SENDING CREW.

BY SUPERVISION LOOKING AHEAD AND PLANNING COORDINATED WITH P & E'S ABOUT WORK, NOT WAITING UNTIL THE JOURNEYMAN RUNS OUT OF SOMETHING TO DO.

COMMUNICATION

BETTER PLANNING

MORE COMMUNICATION BETWEEN CUSTOMER AND TENANT. COMPROMISING NEEDS BECAUSE OF MONEY. SPENDING A DOLLAR TO SAVE 5 CENTS AND ENDING UP COSTING $100.00 LATER

BY USE OF JOURNEYMEN DISCRETION OR BY A COMPETENT SUPERVISOR NOT AFRAID TO MAKE DECISION.

BETTER COMMUNICATION WITH WORKERS.

PLAN AHEAD

HIRE SOME MORE P & E'S & INSIST THEY PUT THINGS IN WRITING & SIGN & DATE FOR SAME.

WE ARE ALL JOURNEYMEN CARPENTER AND SHOULD NOT NEED INSTRUCTIONS FOR MOST JOBS.

POST A DAILY WORK SCHEDULE OF WHERE EACH WORKER SHOULD BE.

ALLOW MECHANIC TO FINISH ONE JOB BEFORE STARTING ANOTHER

BETTER COMMUNICATION W/EMPLOYEES

CUSTOMER NEEDS TO PAY MORE ATTENTION TO DESCRIPTION OF WORK DRAWINGS ETC.

JOURNEYMEN DESIGN/P&E COMMENTS

SOME P & E'S SHOULD GET AN EARFUL FROM JOURNEYMEN P & E SHOULD BE GIVEN MORE TIME TO INVESTIGATE THE JOB BEFORE WRITING IT DOWN.

JOB WALK WITH SITE JOURNEYMEN IN ADVANCE

P & E AND ENGINEERS NEED TO TALK TO EACH OTHER MORE.

P & E GIVE MORE SPECIFIC INSTRUCTIONS ON JOB PACKAGE.

MOST PROBLEM IS ABOUT ASBESTOS. P & E'S SHOULD CHECK THE CONDITIONS OF THE FLOOR OR HAVE THE FLOOR TESTED FOR ASBESTOS FIRST. MOST OF THE TIME WE GO TO THE JOB SITE & FIND OUT THAT THE FLOORING IS 9 X 9 TILES WHICH CONTAIN ASBESTOS. THIS DELAYS WORK.
IT COULD HELP BY P & E'S TALKING TO THE TRADESMEN AND MORE DETAIL ON WHAT EXACTLY THEY WANT DONE.

MORE COORDINATION, MORE PRE-CONS

PLANNER SHOULD BE MORE KNOWLEDGEABLE OF DIFFERENT TRADES. HE SHOULD INSPECT JOB SITE MORE CAREFULLY AND PROVIDE MORE INFO

COMMUNICATION BETWEEN P & E ENGINEERS CUSTOMERS, TENANTS, SUPERVISION, MANAGEMENT JOURNEYMEN

PRECON EACH JOB OVER SERVICE CHIT SCOPE

HAVE THE JOURNEYMAN DO THEIR OWN P&E ON THE JOB THE WILL WORK ON.

FOR ENGINEERS AND P & E'S TO LAY DOWN THE BASIC PLAN AND MAKE DECENT DRAWINGS ORDER A/C UNITS OR HEATERS THEY HAVE CHECKED TO SPECS, BUT LEAVE DETAILS AND SMALL PARTS TO JOURNEYMAN. I SPEND MUCH TIME SIFTING THROUGH USELESS PARTS AS I WOULD PICKING UP SUCH MATERIAL MYSELF.

P & E'S DOUBLE CHECK WITH JOURNEYMEN AND CUSTOMERS TO MAKE SURE JOB IS PLANNED TO THEIR SPECS

INTENSIVE PLANNING AND DETAILING NEED TO BE COORDINATED.

CAREFULLY PLAN AHEAD

GIVE MORE DETAIL ON INFORMATION AND SKETCHES

MORE COMMUNICATION BETWEEN CUSTOMERS, p & E'S & LABOR

YES, WITH THE RIGHT PERSONNEL

MORE INTELLIGENT P&E'S

CUSTOMER GIVE A DESIGN SCOPE OF WORK TO BE ACCOMPLISHED. HEAVE STAFF CIVIL DO THE PLANS AND SPECS.

MORE CONTACT WITH CUSTOMER; CUSTOMER HELD RESPONSIBLE

WHAT JOURNEYMEN LIKE ABOUT THEIR JOB

SATISFACTION OF COMPLETING IT PROPERLY WITH SPECS.

I ENJOY BEING ABLE TO MOVE AROUND ON VARIOUS PROJECTS NOT STUCK IN AN OFFICE ALL DAY.

IT CAN BE VERY SATISFYING WHEN THINGS GO WELL.

THE PAYCHECK

EVERYTHING BUT PAY

I LIKE THE VARIOUS DESIGNING OF SIGNS AND THE TYPE OF WORK REQUESTED FOR THE SIGN SHOP.

ENOUGH TIME IS ALLOWED TO DO A GOOD JOB.

I DON'T KNOW

EXPOSURE TO OTHER TRADES.

DOING A GOOD JOB.

HAVING A JOB

GETTING PAID

THE PACE

THE FINISHED PRODUCT

FREEDOM OF MOVEMENT

EVERYTHING

INDEPENDENCE & TRUST FROM SUPERVISORS LOW SUPERVISION REQUIRED & THEY ARE VERY HELPFUL AND COURTEOUS

WORK WEEK SCHEDULE

I HAVE BEEN ABLE TO STAY BUSY. SO FAR IT'S BEEN SECURE. MONEY'S OKAY.

THE LONGEVITY

MOST OF THE JOBS I AM GIVEN I AM ABLE TO DO THEM THE WAY THAT I WANT.

THE LOCATION AND CUSTOMERS.

SATISFACTION OF DOING A JOB WELL DONE.

WHAT I LIKE MOST ABOUT MY JOB IS THE LOCATION AND THE PEOPLE I WORK WITH.

I CAN FIELD MEASURE MY WORK DETAIL SHOP LAYOUT AND INSTALL AND IF MY WORK DOES NOT FIT ITS MY PROBLEM.

I LIKE MY JOB I LIKE THE CREWS I WORK WITH AND I LIKE MY SUPERVISOR

THE CONSTANT CHANGE IN SCOPE OF VARIOUS ASSIGNMENTS. THE CHALLENGE OF SOLVING PROBLEMS.

I HAVE A FREE HAND TO USE MY JUDGEMENT AS NEEDED.

THE WELL MANAGED ATMOSPHERE, GREAT GUYS TO WORK WITH, PROFESSIONAL ATMOSPHERE.

NO UNDER PRESSURE TO GET JOB DONE, ALL THE MEN HAVE A GOOD ATTITUDE.

THE FREEDOM TO DO A QUALITY JOB IN A TIMELY MANNER.

I FIND GREAT SATISFACTION LOOKING BACK ON A JOB WELL DONE, OR GOING BACK YEARS LATER TO SEE MY SAME REPAIRS OR NEW CONSTRUCTION STILL IN PLACE & OPERATING.

THE FLEXIBILITY TO DO THE JOB RIGHT MY SUPERVISORS KNOW WE ARE JOURNEYMEN AND VALUE OUR OPINIONS AND OUR INPUT, ENJOY THE WORK.

I GET TO WORK EVERYDAY. RDO

THE FREEDOM TO PERFORM & COMPLETE MY TASKS IN THE MANNER I KNOW IS CORRECT

WE'VE GOT SOME WHERE TO GO AND WORK EVERYDAY, LOTS OF WORK AND I LIKE THE GUYS I WORK WITH.

THAT MY FOREMEN TRUST ME TO DO A GOOD JOB AND THEY ARE NOT ALWAYS LOOKING OVER MY SHOULDER.

THE KNOWLEDGE I HAVE IN THE TRADE

THE ABILITY TO DO A VARIETY OF WORK AS A MAINTENANCE WORKER.

THE PAY AND BEING ABLE TO IMPLEMENT CHANGE.

THE VARIETY OF WORK

EXPECTED GROWTH AND IMPROVEMENT

WHAT JOURNEYMEN DISLIKE ABOUT THEIR JOB

LACK OF COORDINATION, MATERIALS & EQUIPMENT

HAVING TO DEAL WITH BRIDGE TRAFFIC IN (AM) NOT BEING OFFERED OVERTIME.

THE HASSLE TO GET TOOLS AND EQUIPMENT TO THE JOB SITE.

BETTER TRAFFIC CONDITIONS GETTING ON OR OFF NORTH ISLAND & THE BRIDGE ALSO, SUPERVISOR OR PERSONNEL ERRORS THAT UNNECESSARILY SCREW UP EMPLOYEE PAYCHECKS.

DUE TO THE PHYSICAL STRESS OF THIS JOB I WOULD LIKE TO SEE THIS TRADE CHANGE FROM WG-9 TO WG-10.

HOW SUPERVISORS AND LEADERS ARE SELECTED. I DON'T LIKE THE OLD BUDDY SYSTEM (FAVORITISM). MY PAY.

MORE MONEY

LACK OF UPWARD MOBILITY AND TRAINING.

WAGES

TRAFFIC ON CORONADO BRIDGE, LACK OF COMMUNICATION WITH PERSONNEL OFFICE.

MORE MORE MONEY

NO COMPLAINT

GET THE RESPECT FOR THE TRADE THAT HE OR SHE IS DOING, THAT THE P & E'S AND SUPERVISION CONFRONT AND TALK WITH THE TRADESMEN UNDERSTANDING THAT WHAT'S ON PAPER MAYBE DIFFERENT PLACING IT ON A BUILDING OR WALL.

THE PAY

PEOPLE WHO ARE IN THE SYSTEM WHO GET TRANSFERRED INTO ANOTHER DEPARTMENT AND DON'T KNOW TOO MUCH ABOUT THE TRADE. UNQUALIFIED JOURNEYMEN WELDERS.

THE PAY, PLUMBERS DESERVE WG-10 OR WG-12 PAY

THE PLANNING

WORKING IN CROWDED OFFICE SPACES CHANGES IN JOB PLANS AFTER INITIAL START. LOUSY CLEAN UPS FIXING OTHERS PEOPLES MISTAKES. NOT BEING ABLE TO FINISH A JOB I'VE STARTED.

LET JOURNEYMEN BE MORE RESPONSIBLE TO MAKING DECISIONS JUSTIFIABLE WITHOUT FEAR OF RECOURSE.

IT IS SOMETIMES DIFFICULT TO GET THE RIGHT MATERIAL TO DO OR FINISH A JOB AND IT OFTEN TIMES TAKES TOO LONG TO GET THE MATERIAL.

WORKING STAGED AND PWC PLANNED SPECIFIC JOBS

EQUIPMENT AND TOOLS.

I WOULD LIKE TO BE ABLE TO ADVANCE TO A HIGHER SKILL LEVEL VIA ON THE JOB TRAINING. INSTEAD OF ONLY BEING ALLOWED TO DO COMMON LABOR JOBS.

NOTHING

MORE MONEY, MORE BONUS, MORE WORK.

FILLING OUT THIS STUPID PAPER WORK.

I LIKE MY JOB.

THE PAY

THE GRAFT AND UNFAIR PRACTICES USED FOR MERIT PROMOTIONS.

I'M HAPPY

PAPER WORK

BETTER PAY.

THE AMOUNT OF CONFUSION DUE TO CONSTANT CHANGE.

WE GO TO CLASSES ON THINGS LIKE TQL BUT MIDDLE MANAGEMENT WILL NOT ALLOW IT TO HAPPEN AS IT THREATENS THEIR POSITION. LETS GET TQL GOING NOW OR WELL BE LOOKING FOR WORK TOMORROW.

CONTINUE CHANGE IN PROGRAM AND DIRECTION OF THE CENTER

TOOLS JOURNEYMEN HAVE TROUBLE GETTING

PORTABAND (LARGER, FOR 4" PIPES), CORE DRILLING EQUIPMENT, NOT AVAILABLE AT NORTH ISLAND, NOT ENOUGH GOOD LADDERS. TROUBLE GETTING SCISSOR LIFTS, FORKLIFTS, SNORKEL LIFTS TO JOB SITE PRIOR TO START.

QUALITY PORTABLE JIG SAWS (WOOD) FINISHING CARPENTER TOOLS - (BITS) DRILLS, SANDERS

SAWZ-ALL, HAMMER DRILLS, DRILLS, SNAP-CUTTERS.

SAFETY SHOE REIMBURSEMENT MONEY.

FORKLIFT, FLOOR SANDER, 100 LBS ROLLER.

DRILLS, THE SIGN EQUIPMENT IS NOT SUFFICIENT TO PERFORM MY TRADE AND IT'S OUTDATED.

FORKLIFTS, SAWZ-ALLS, DRILLS

SPRAY EQUIPMENT, AIRLESS, ELECTRIC TOOLS SUCH AS SANDERS, GRINDING TOOLS, LADDERS

6' LADDER

PORTABLE WELDER

THE ONE YOU NEED RIGHT THEN, PNEUMATIC NAILERS OR STAPLERS WITH ACCOMPANYING HOSES AND COMPRESSORS

METAL STUD & TRACK HAND SHEAR. DOUBLE CUTS.

PNEUMATIC NAIL GUNS

HAMMER DRILLS

ELECTRIC JACK HAMMERS, PROPER CORE DRILLING MACHINES FOR DIFFERENT APPLICATIONS.

ELECTRIC POWER TOOLS THAT WORK PROPERLY AVIATION SNIPS, CIRCUMFERENCE STEEL RULER PROPER SIZE SCREEN RULERS.

SOME OF THE ELECTRICAL TEST TOOLS ARE IN SHORT SUPPLY

HILTI GUNS AND DRILLS

NO PROBLEM

PNEUMATIC NAIL GUNS, NAILS FOR SAME

TRENCHER, PVC BENDER, LADDERS

NEED MORE CARPENTER TOOL AT TOOL ROOM OLD TOOLS, NEED TO PURCHASE NEW TOOLS SKILL-SAWS, MAKITA BATTERIES, CHOP SAWS

SANDERS,CHOP-SAWS

SOLDER TORCH

CONSUMABLES JOURNEYMEN HAVE TROUBLE GETTING

1/8" DRILL BITS, QUALITY WOOD BITS BRADS/FASTENER TYPE

GOLD BOND, JOINT COMPOUND, THE USED BRAND IN SHOP STORES IS GARBAGE.

ADHESIVE

DRILL BITS

EAR PLUGS

SIX FOOT LADDERS

JUST ABOUT ANY ELECTRICAL TOOL

FASTENERS, SCREWS, UTILITY KNIFE BLADES, SHOP STORES IS TERRIBLE.

WELD LENSES

GOOD PRIMER & WET R DRY GLUE, COPPER FITTINGS THE RIGHT ONES THEY HAVE OUTDATED INVENTORY.

CARBIDE TIPPED SKILL-SAW BLADES

NUMBER SEVEN DRILL BITS

DUST MASKS

FROM OUR PWC STOCK THERE IS USUALLY ONE OR TWO ACCESSORIES TO A JOB, WETHER IT IS BOX CONNECTORS WIRE OR SOMETHING LACKING AT ANY GIVEN TIME, THAT CAUSES TRIPS TO ANOTHER SHOP STORE, OR A DRIVER WHILE I GO TO ANOTHER JOB, LOST TIME EITHER WAY. THE SHOP STORE PERSONNEL ARE ALSO BOUND BY THEIR OWN LIMITATIONS OF INADEQUATE INFORMATION AND RESTOCK MONEY BOUNDARIES.

HEX HEAD SCREW ADAPTER

NAILS FOR PNEUMATIC NAILERS.

CIRCUIT BREAKERS

SKILL SAW BLADES, WRONG TYPE PURCHASED AT SHOP STORES!

DRILL BITS, SAW BLADES

TEFLON TAPE, PENOIL

DRILL BITS

SOME DRILL BITS,FASTENERS, WE NEED A FASTENER PEB

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Vita

Scott Jacob Waidelich was born in Newark, New Jersey on March 10, 1965, the son of Leni G. Jaehn and George Morgan Waidelich, Sr. He graduated from the United States Naval Academy in Annapolis Maryland with a Bachelor of Science in Mathematics in May of 1988. Upon graduation he was commissioned as an Ensign in the Naval Civil Engineer Corps. In 1994, he earned his Masters of Business Administration degree from National University, San Diego, California. He is an Engineer in Training in the state of California. In August, 1995, he entered the graduate School of the University of Texas.

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